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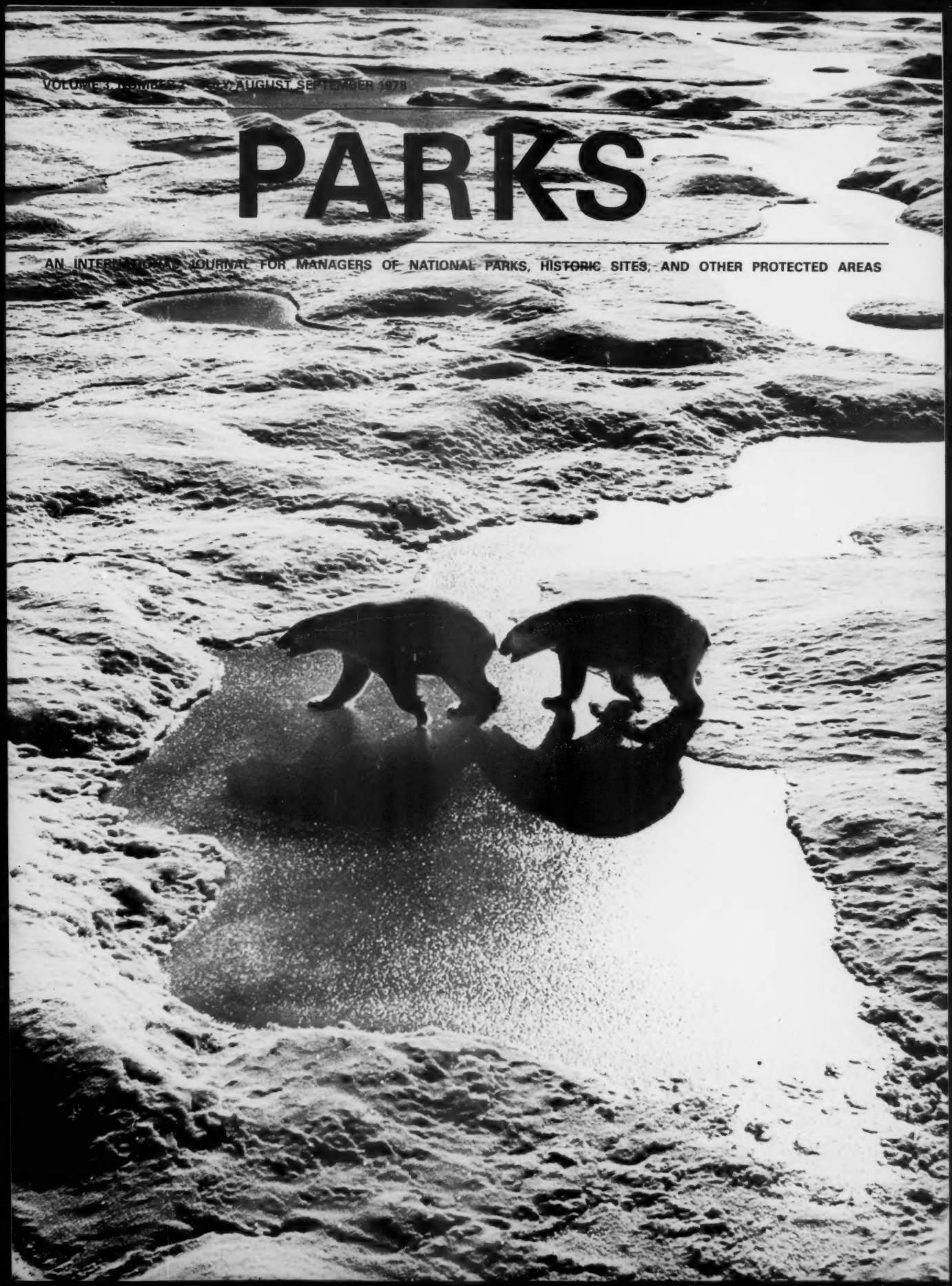
PARKS

AN INTERNATIONAL JOURNAL FOR MANAGERS OF NATIONAL PARKS, HISTORIC SITES, AND OTHER PROTECTED AREAS



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Front cover: Polar bears in the Canadian Arctic. These great carnivores are found in two of Canada's proposed new Arctic parks, Wager Bay and the Northern Yukon Territory. Back cover: A Papua New Guinean headman in traditional ceremonial costume. Varirata National Park. Photo: E. Lindgren

PARKS Magazine is an international publication for the exchange of information on the planning, use and management of the world's national parks and other protected natural and cultural resources.

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Bernard Salvat

Trouble in Paradise Part 1: Assault on Coral Reefs and Lagoons

Coral reefs are among the world's richest natural environments. With a nearly endless diversity of plant and animal species, they form systems of the most intricate inter-relationships; environments that are masterpieces of symbiosis between microscopic plants and animals, both at species level and community level. Coral reefs are practically self-nourishing and are one of the finest illustrations of the ecosystem concept. Along with mangroves, coral reefs are a distinctive feature of coastal areas in most tropical regions and in many thousands of island systems. At least 400 islands or atolls in the world's tropical seas have actually been created by coral reefs.

Research on the effect of disturbances in the coral reefs has only recently started in this tropical environment — some hundred years late compared with that on temperate marine ecosystems. The reef environment has proved vital in the subsistence economy of millions of people in developing countries. It is now subject to severe human pressure resulting from coastal development and pollution stemming from (a) social and economic evolution which tends to separate mankind from his ancestral natural environment; (b) powerful technological factors and, (c) poor knowledge of the structure and functioning of this ecosystem. Coral reefs are protected only within some 40 parks and reserves throughout the world, whereas thousands of land-based reserves have been established as well as a few hundred coastal marine reserves.

Two successive articles will survey the present relationships between human activities and the coral reef environment. The first will outline the present situation which has led to various forms of degradation and change of the natural environment. A second article will stress the need for rational use of the coral reef environment and the establishment of means for its protection, both in the traditional sense of parks and reserves, and in the sense of economic reserves as a safeguard against uncontrolled, irrational exploitation.

General Reef Facts

A few facts about coral reefs: They cover more than 200,000 km² of the planet's surface between latitudes 35° N and 32° S and stretch along more than half of the shorelines in that area. Madrepores and corals are the main "constructors" of the reefs which can only develop and thrive under relatively limited environmental conditions. These are mainly: *temperature* (20° to 28° C); *penetration of light* into the water, which is necessary for the symbiotic algae living in reef-building corals (between 0 and 70 m for clear water), and *salinity* close to that of the ocean. A high nutrient or plankton content in the sea water is not an indispensable requirement for the development of coral reefs, as evidenced by the presence of coral atolls in the Central and Eastern Pacific, in an ocean area poor in nutrient materials. Coral reefs do not occur along the western coasts of continents due to the general oceanic circulation, which tends to bring cooler polar waters to these coasts, and especially to upwelling cold deep waters in such areas. Reefs are distributed in two main biogeographic provinces: the Indo-Pacific area and the Caribbean zone.

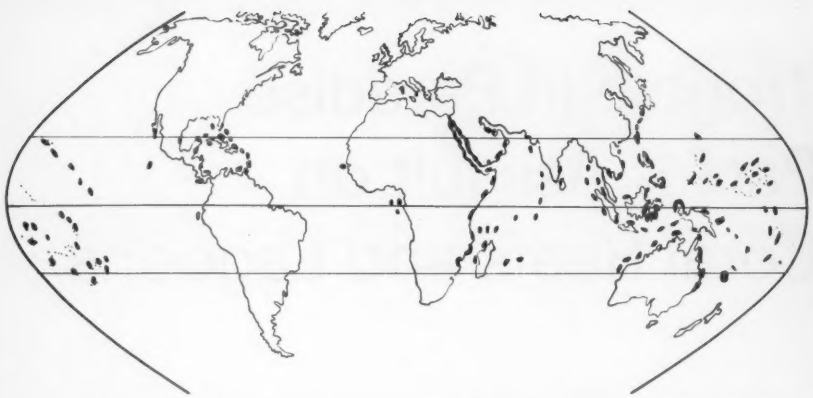
The coral community — consisting of a complex of the coral building animals, associated symbiotic plants, molluscs and worms, and resident or transient fishes — is a closely knit system. This system has evolved in the course of time in a relatively stable oceanic environment.

Also, for physiological reasons, organisms evolving in the tropics have tolerance for environmental change far lower than in temperate environments. Thus when the usually stable tropical environment does change — e.g., by man's manipulations — individual organisms are ill-prepared to tolerate those changes. They are quickly felt within the community and may have disastrous effects.

The degradation suffered by coral reefs is usually related to physical factors such as heat pollution, to oil, pesticides and other chemical pollution, and to bacteriological pollution. An additional classification will be used in this article, based on the nature of human intervention in the coral reef environment: *direct impacts* on the considered ecosystem, or *secondary effects* from outside sources. In the latter case pollution may be generated out at sea (pelagic) or on land (terrestrial), depending on where polluting activities are taking place.

Fishing and Fishing Methods

At present there is no integrated large-scale industrial exploitation of plant and animal species common to the reef environment. However, commercial exploitation of reef fishes traditionally has been carried out to supply urban centers, or more typically, simply a cropping activity for domestic subsistence consumption. This used to be the only type of fishing practiced: it spared the environment and ensured the renewal of exploited fish resources, which is vital for human existence. Unfortunately, new fishing techniques and methods have been developed in some areas and are now disrupting the coral reef environment. For example, fishing may now be carried out over extensive reef areas, with fishermen moving in a line to drive the fish into their nets. Anything edible — large and small — is taken. Traditional fishing tackle — fishing hooks and lines, spears and nets — find competition from spear guns which are sometimes used, even when prohibited, with underwater breathing equipment. The species that are most in demand move deeper down and the larger older specimens disappear, forcing the fisherman, if he is to continue meeting the demand, to take more smaller fishes, including those not yet old enough to reproduce. Explosives are frequently used for fishing in areas where engineering works are in progress, as these materials are then easily available. Underwater blasting is a terribly efficient killing technique which indiscriminately destroys habitats and their inhabitants (Christian, 1973), but only part of the fish thus killed float up to the surface and are utilized. Strong



Left, coral reefs are found around the world in tropical seas, generally between latitudes 35° North and 32° South. They constitute the world's most important community of living shallow water organisms. Map courtesy of Le Courrier de la Nature *(Paris), March-April, 1974. Right, emerging crown of atolls: a succession of small islands covered with coconut palms, with channels leading from the ocean to the quiet lagoon waters. Photo B. Salvat*

organic pesticides developed for other purposes are also used to kill fish although this is fairly infrequent.

Such is the condition of coral reef communities, overexploited and degraded, in the neighborhood of developing urbanized areas. Local people complain "There's nothing more to be got" and the depleted area spreads further and further, even faster than the developing city.

Collection of Shells and Other Organisms

Whether through collecting of shells, black coral, small coral fish, madrepores (stony corals) or other reef organisms, deterioration is caused either by tourists collecting for pleasure or by professionals working for commercial purposes. In any case, ignorance of basic ecological rules, disregard for marine life, irresponsibility towards our common natural heritage and the lure of profit, all result in considerable damage, particularly if collecting activities are considered on a global scale in coral reef areas where year-around tourism is encouraged. This situation could be remedied by education and regulations, especially by the enforcement of regulations in many countries with existing adequate legal structures.

Extraction of Coral Sand from Lagoons

Dredging and removal of coral sand for construction material or harbor development is one of the most damaging activities. The dredged areas are irretrievably damaged: a meters-thick layer of extremely fine sand is left which provides little chance for subsequent attachment and survival of coral larvae and which is constantly stirred up by the swell (Grigg, 1970; Marsh and Gordon, 1974). Around the dredged areas, clouds of suspended sediment smother the corals and other reef organisms. Virtually every single dredging site can become an esthetic and biological blight. Decisions about the location and number of dredging sites are typically taken by responsible authorities within a socio-economic system which does not take into account — by ignorance or sometimes by design — the natural heritage, thus leading to irreversible destruction. There are a number of ways to alleviate and control such activities. These are, principally, sand extraction from immediately behind the fringing reef (where sand is produced and fine-grained sand is less abundant) instead of from the deeper lagoon area; limitation of the number of dredging sites; preliminary studies for the selection of such sites, and technical constraints for dredgers.

Nuclear Experiments

Nuclear explosions in coral reef ecosystems have been generated by France (Tuamotu archipelago: Mururoa, Fangataufa), the U.S. (Marshall archipelago: Bikini, Eniwetok) and by the United Kingdom. The chief effects of these explosions are radioactive. Radioactive elements first contaminate the primary planktonic and benthic producer organisms and, depending on trophic interrelationships, they are concentrated along the food chain. Radioactive contamination obviously depends on the particular conditions of the explosion as well as on the character of the nuclear charge. Natural decontamination occurs more or less quickly. Following an explosion on Bikini, consumption of fish from Rongelap atoll (160 km away) was prohibited during four years (Hines, 1962).

Damage caused by nuclear explosions, just as by other powerful blasts, is proportional to their power. The environment is disrupted and laid more or less completely waste according to its distance from the blast; changes in flora and fauna have been observed in which algae and echinoderms become dominant.

Development of the Lagoons

Changes resulting from private ownership developments of the shoreline such as construction of marinas, alteration of the coastline, mining and erosion, replacement of the shore by artificial amenities such as sea walls and pools as part of hotel units—all these progressively encroach upon lagoons and reefs, heedless of the role played by each altered site in the system that previously had been functioning through thousands of years. The destruction of fringing reef areas which have served as nursery grounds for a variety of species living elsewhere at adult stage unavoidably affects the population stocks of such species. Mention should also be made of the vast development projects, involving entire reef systems, which will come into existence in the future: the superharbor of the Palau Islands designed for oil stocking operations is a forerunner of such installations, and at Palmyra (Ile de la Ligne) the semi-isolation of an atoll lagoon through large scale development has already caused its death.

As a last point, it has been shown that there is a relationship between "development" of reef areas and the outbreaks of human poisoning through fish consumption (ciguatera poisoning, Bagnis, 1972). The relationship is still poorly understood but apparently extensive alteration of the reef—through dredging, blasting or pollution—encourages

development of different food sources (algae?) which may cause certain fishes to become highly poisonous to humans.

Secondary Pelagic Pollution

This is mainly caused by oil and oil-based products of which over 4 million tons are accidentally or deliberately discharged into the sea every year. Various studies have shown that oil slicks which accidentally reach coral reefs do not affect stony corals when these corals are permanently submerged (Grant, 1970; Rutzler and Sterrer, 1970), although the situation is different for corals periodically exposed by low tides (Johannes et al, 1972). However, in the case of heavy oil pollution, many reef organisms are affected (Gooding, 1971), especially fish. The impact is increased by the fact that hydrocarbons use up large amounts of dissolved oxygen in their degradation process, thus altering the oxygen content in the water. Specific examples of oil pollution have been less frequent in tropical areas than in temperate areas, but reefs have also had their *Torrey Canyon* or *Amoco Cadiz* disasters: for example, the wreck of the *Stoner* at Wake Island, north of the Marshalls, resulted in 6 million gallons of oil poured into the sea. Moreover, dispersing agents like detergents used in such cases are just as toxic, as hydrocarbons, if not more so, for reef organisms (Cohen, 1973), as has been shown for the fauna of temperate areas.

Secondary Terrestrial Pollution

This type of pollution, originating on land, may be considered at present as the most damaging for coral reefs and lagoons. There are four main sources: engineering works, agricultural practices, industrial plants, and sewage from urban areas.

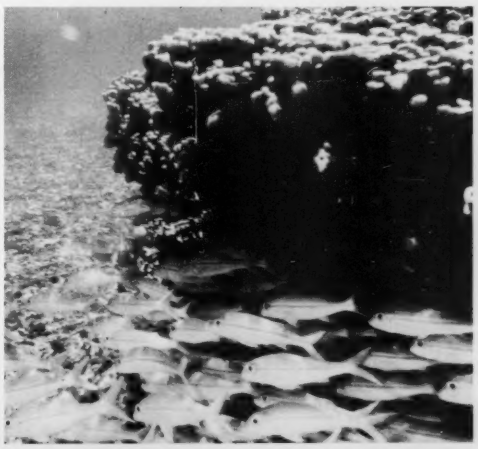
Large scale engineering works that reshape terrestrial landscapes — changing topographic profiles, establishing highways and airport runways — usually lead to destruction of the vegetative cover. This is followed by heavy soil erosion. During rainy periods considerable amounts of soil are washed into streams and rivers and discharged into lagoons. Sediment deposits at river mouths build outward into the lagoons; fine silt smothers reef communities and buries the corals; and lagoon waters become permanently and heavily turbid. Such occurrences are frequent on a great many islands of the Indo-Pacific and Caribbean regions. The case of Kaneohe Bay in Hawaii, is typical in this respect: the mean depth of the bay has decreased by 1.5 m in less than a century (Roy, 1970). Animals, especially goats and sheep, introduced on many islands by early European seamen, have totally destroyed the natural plant cover with ensuing soil erosion and silting up of the coastal area.

Intensive agricultural practices make massive use of all kinds of pesticides (insecticides, herbicides, nematicides ...): organo-chlorines (the most toxic) such as Endrin, Lindane or organo-phosphates such as Abate or Malathion. The yearly world production of DDT and organo-chlorines is rated at 400,000 tons, a fourth of which is thought to enter the seas and oceans. The concentration of these products upwards along the food chain is considerable. DDT has contaminated the whole biosphere. Accidents have already occurred in coral reef areas: Endrin poisoning in the Truk lagoon in the Carolinas in 1970 (Bourns, 1970); Lindane poisoning in the Tokelau Islands, which caused the death of the coral reef communities and human poisoning as well.

Destruction and regression of reefs and lagoons also occur through *industrial development*, especially through discharge of factory effluents. *Sugar cane refineries* were one of the first industries in tropical areas to discharge cane residues into the sea, a type of waste that causes high sedimentation and turbidity. This situation is particularly critical in the Caribbean and the Hawaiian Islands (Burm and Morris, 1971; Grigg, 1972). *Mining complexes* dump a large part of their wastes into the sea: the worst example in this respect results from nickel mining in New Caledonia.

Introduced more recently, *power and heating plants* generate another type of pollution. Discharge of heated water into the coral reef environment proves disastrous, even when the water is only a few degrees above normal, as lethal temperatures for reef organisms are very close to optimum temperatures. Resulting reef mortality within a wide radius has been investigated and documented in Florida (Thorhaug et al, 1973) and on Guam (Jones and Randall, 1973). In temperate zones discharge of heated water has caused some migrating species to remain throughout the year in this artificial habitat. *Desalinization units* discharge oversalted water with high heavy metals content. This oversalted and thus heavier water does not mix well with surrounding waters, and can have substantial effects on benthic organisms. Pollution from heat and desalinization plants is bound to increase in the future as demands for energy and water increase.

Left, extraction of coral sediments is one of the main causes of reef degradation throughout the world. The dredge extracts coral sand, destroying the habitat and churning up very fine particles which settle on surrounding communities and smother them. Photo B. Salvat. Right, coral reef fish are an important source of food for island populations which have a subsistence economy. These fish are the first to desert the reef when environmental conditions, and especially oxygen content, start deteriorating. Photo B. Salvat



Urban development is a source of pollution through sewage discharges. Waste treatment facilities often are non-existent, or if there are any, they are ineffective.

Up to now there has been little research on bacterial pollution in coral reef areas, which may reach levels far above those acceptable to the World Health Organization (1000 coliforms per 100 cubic cm.) This pollution affects humans but does not appear to influence the reef community. Chemical pollution is produced by sewage from urban centers (detergents, organic matter) and gives rise to high contents of nitrogen and phosphorus which result in eutrophication of lagoon habitats, with considerable damaging effects on the community: proliferation of certain algae; death of corals and fish especially; invasion of communities dominated by sponges and certain echinoderms. These processes leading to the death of reefs have been closely investigated in Kaneohe Bay, Hawaii (Smith et al, 1973).

Conclusion

Briefly, such are the damages and alterations to coral reefs resulting from human activities. Pelagic pollution will soon be a common occurrence in coastal areas all around the world, since the world's oceans and seas communicate with each other. Degradation through direct action, as well as telluric pollution, will increase rapidly in the near future where coral reefs are located in developing areas that are on their way to industrialization. Will mankind be discerning enough to realize that there is a limit to acceptable environmental destruction? Will man have the wisdom and will to master and control his own activities—does the possibility of preserving natural conditions still exist? Action in favor of the establishment of parks and reserves is a first answer to this challenge. This will be reviewed in a second article.

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Elisabeth Beazley

The Culzean Park Center: A New Use for an 18th Century Model Farm

On the Firth of Clyde in Scotland, and an easy drive from Glasgow's vast conurbation, the historic castle of Culzean (pronounced 'Kullain') and Scotland's first Country Park dominate a cliff overlooking the sea.

Owned by the National Trust for Scotland, it is a place of rare beauty and interest which attracts and is planned for large numbers of visitors. A major factor in the success of this new park is, unquestionably, the remarkable visitor center, a careful adaptation of the Home Farm buildings which were designed more than two centuries ago by the famous architect and furniture designer, Robert Adam.

Conservation here, as elsewhere, is inextricably integrated with decisions made long ago. In 1759, when Sir Thomas Kennedy of Culzean became 9th Earl of Cassillis, surprisingly he decided not to move to the much grander family seat nearby. Instead he started a great scheme of land improvement which was the beginning of the Culzean we know today.

His brother David who inherited in 1777 clearly had the urge to build. He immediately called in his contemporary, Robert Adam, and they worked together at Culzean for fifteen years.

The dramatic sea elevation of the new Mansion House which they built was the climax of the grand design which runs along the edge of the steep cliff and ends with Adam's splendid Home Farm, about a quarter of a mile to the north. The farm's siting is in itself surprising; it plays a vital part terminating the cliff top composition. The design (Fig. 1.) consists of four T-shaped buildings arranged with their tops together to form a square, with entrances at the corners where the Ts join. The dominant axes are the diagonals with views through the portals which connect the Ts.

The finest records of Culzean are those from the sea as seen in paintings by Alexander Nasmyth. It is hard to believe the view: the cliff-top array of castellated buildings and the splendid woodland beyond seem to belong to some magic landscape.

The existence of these buildings and trees is yet more unlikely when the hard facts of conservation and survival are considered. Sandstone is not the ideal material to withstand two hundred years of exposure to salt-laden winds, nor is planting likely to prosper. The depression and the war years of this century were no easier here than elsewhere.

In 1945, the 5th Marquess of Ailsa offered Culzean Castle and 531 acres to the National Trust for Scotland, a condition being that the use of the top floor of the Castle should be given to General Eisenhower for his lifetime. The property was offered unendowed and, in a magnificent moment of faith, accepted. Financial appeals were launched and great work was done, but the money available could not begin to meet the needs. Culzean, the brightest jewel of the National Trust for Scotland, soon became a financial millstone.

Under the Countryside (Scotland) Act 1967, the Countryside Commission for Scotland was established and substantial government money could be granted for newly created country parks. On their advice Culzean was declared Scotland's first country park. The Trust remained indisputably and inalienably the owner and three local government au-

Left, plan of the Home Farm as prepared by Robert Adam. Center, plan of the Culzean Park Center as restored and converted. Right, the Home Farm after restoration and conversion for use as the Culzean Country Park Center.

Figure 1.

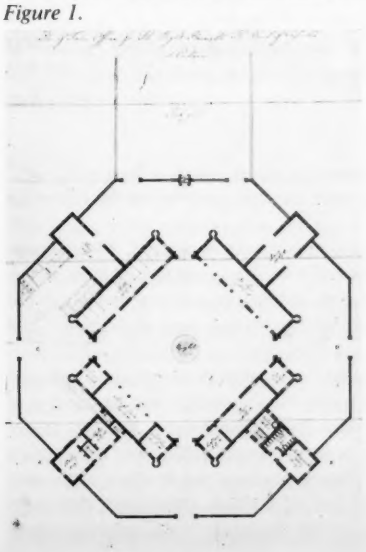
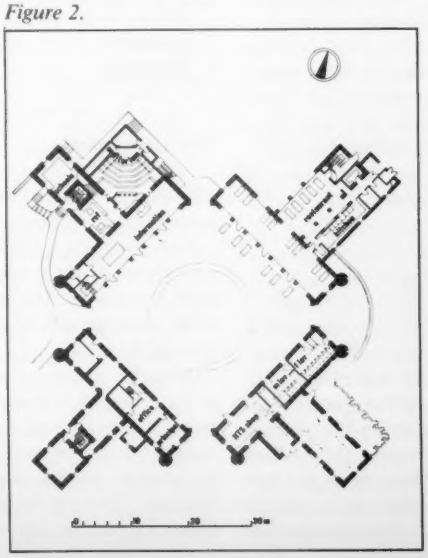


Figure 2.



thorities, Ayr County, and Ayr and Kilmarnock Burgh Councils were responsible for the Park, which was to remain in the management of the Trust.

The needs of the country park have been described as "views-loos-and-brews," — scenery, comfort stations and restaurants. Culzean abounds in the first but a planned increase in visitors from 118,000 to 250,000 in five years meant that other provisions would be inadequate. The educational and interpretive potential of the Park was also to be developed.

In a report made in 1969 it was determined:

- The key to the plan will lie in the siting of the Visitor/Information/Administrative Centre.
- The essential character of Culzean must be instantly experienced by the visitor without explanation; the rare and marvellous juxtaposition of civilized buildings, splendid woodland and open sea.
- The Centre will engender a great deal of traffic (service and tourist) so must be sited where this will not cause congestion. Equally important, its siting must allow much of the park to remain secluded.
- It should be in surroundings which will encourage the public to wander and not necessarily make first for the Castle, which already at times seems to be over-visited.

Inevitably, any new building at Culzean would either wreck Adam's composition in fulfilling the first requirement or be sited where there were enclosed views of parkland but little else. In a search for an answer the idea of using Adam's Home Farm buildings came into being. The fact that its new use would conserve a splendid eighteenth century building was a blessed byproduct, seized on the instant the idea had formed.

Not only did its siting prove ideal but, in an astonishingly concise manner, its courtyard with the sea and woods framed by the four great turreted archways leading from it, said everything that needed to be said about Culzean.

Adam's building seemed to be tailor-made for its new use. The farmyard is a courtyard of great distinction. It forms a sheltered outdoor room, a place to linger in the sun. Two of the sides were arcaded for carts and implements. The arches, then blocked up, might be re-opened and glazed where necessary, solving the perennial problem of providing sufficient window area in a converted building.

Next it had to be decided whether the idea was practicable in terms of floor area and circulation. Clearly there was little point in proceeding if the buildings would not accommodate the visitors' needs with a minimum of alteration. If their historic and architectural character had to be compromised, the operation would be pointless (and illegal). The needs were:

- A big information space where visitors could find out what was going on.
- A simple auditorium seating eighty for introductory slide shows, school briefings, evening lectures and discussions.
- Exhibition space for the story of the estate.
- A very simple laboratory, and shelter for school groups in wet weather.
- A self-serve restaurant seating 200, kitchen and storage.
- National Trust for Scotland shop and store.
- Lavatories
- Shelter where visitors could picnic in bad weather (also to be used for temporary exhibitions).
- Administrative offices for the Country Park (two rooms and storage area).
- A house, since it was important that someone should live on the spot.

The plan turned out to be feasible so the next major decision was the appointment of an architect. It is easy enough to have an idea but quite another matter to translate it into architectural reality. The qualities needed were great sensitivity to the essential character of the farm buildings and the imagination to make a robust conversion to its new use — a rare combination. Skill in the restoration of stonework would obviously be essential. The laborious job of looking at a large number of buildings and conversions done by our short list of architects was well worthwhile. Geoffrey Jarvis of the Boys, Jarvis Partnership was selected because of his other successful buildings, because his practice could be geared to our kind of work, and because we thought it likely we would all get on (and so it proved). Too often, we felt, architects are selected on the last of these criteria alone.

The Information Room. Photo: William McCallum.

The planning stages went smoothly but the quantity surveyor's estimates (January 1971) were our first great shock: £275,000. Prefabricated buildings were considered as an alternative but the saving was surprisingly small. With admirable foresight the Joint Committee and the Countryside Commission for Scotland decided to go ahead, with the reservation that the auditorium and exhibition rooms must wait until money was available.

The final figures were:

	£
1. Stonework repair	35,000
2. Contract for alterations	170,000
3. Demolition of external buildings, formation of car park, and siteworks outside of main building area	12,200
4. Auditorium	24,000
5. Exhibition	15,000
	£256,200

The conversion

The success of any building work depends on detail so the following notes may be of interest.

Stonework: The local sandstone was very weathered. Many stones were replaced; others were dressed back to a sound face. All the arches in the courtyard had to be refaced, and nine new arched openings were made inside the restaurant. Corbels supporting many of the turrets had to be replaced.

When the post-Adam additions were taken down stone was re-used in the new work wherever possible but it turned out to be cheaper to build cavity walls with new stone than to use the old. The new stonework is chiefly Blaxter but in order to give the variation of color which occurs in the original work, Darney, Stainton and Prudhoe stone were also used. To avoid the bland look of machine sawn stone, they were tooled by hand on site. Part of the character of the existing rubble

The Exhibition in the loft. Photo: Henk Snock.

masonry derives from its very rough mortar with small pebbles embedded in it. The new mortar, which has a similar mix of pebbles, would not have weathered to match the original for some years so a *very mild* sand blasting was used both to clean the stone and minimize the patchwork effect of repairs and to mellow the new pointing.

Roofs: Adam's quaint trusses and timbers were examined and replaced where necessary and the roofs relined, insulated and reslated with re-used West Highland slates.

Timber: Much of the carpentry work is new. Big sections of timber have been used wherever possible to maintain the farm's character. For example 12- by 12-inch (30 x 30 cm) rough sawn hemlock baulks have been used to support the exhibition loft. Exposed timbers have been treated with a diluted preservative stain and a clear flame retardant, the proportion of color being carefully mixed to blend the color of new work with the existing timber.

Flooring: The information room is paved with Caithness stone slabs and the restaurant with quarry tiles; both have underfloor heating. First floor rooms have timber floors; the loft only is carpeted with fibre tiles for sound insulation (this is slightly out of character but few people are disturbed by it).

Glazing: The arches have been glazed direct into a rebate cut in the stonework so that from the outside no window frame interrupts their original pure outline.

The plan and how the building is used

The notes which follow are in no way a full description, but include details which may be of interest in showing how the buildings work and the reasoning behind the plan.

The plan (Fig. 2.) was devised to allow the visitor to follow a natural sequence if he wished but not to force him into a "pipeline."

A large squarish room was needed for the auditorium and since the existing buildings were too narrow, it is an addition: a plain stone lean-to built in the angle of the T formed by two wings of the Adam structure. Seating is on steps which the natural fall of the ground towards the cliff accommodates well. A ten minute introductory slide show about the Park runs continuously at busy times. Films and lectures for which an entrance fee is charged take place in the evenings. They are particularly popular with campers (the Camping Club of Great Britain and Ireland lease a site on the edge of the Park).

The exhibition begins with the Culzean landscape and the geology which forms it. Adam's lunette windows frame views which relate the exhibition to the real world, but this is at times submerged in sea mist, so it is augumented.

The visitor is then introduced to the 9th and 10th Earls of Cassillis and to Robert Adam, the key figures in the story, and finds himself in Adam's office in London, the desk strewn with plans. After this, in the old loft, he sees what actually happened to the estate and the dramatic effect of the agricultural revolution on the lives of the tenants. There is little doubt that the shape of the loft (it is like being under an up-turned boat) adds enormously to the character of the exhibition. It is unlikely that the headroom would be permitted in a new building.

We were exceptionally fortunate in the high quality of voluntary help given by professional people, particularly historians, in the preparation of the exhibition. This made exhaustive research in family papers possible and work already done on parish documents readily available. Unfortunately, no farm or domestic artifacts were forthcoming when the exhibition was planned: perhaps a reflection of the increased number of folk museums and collectors. This lack could have led to a flat graphics display which, however good, might be better read as a book. Hence the delightful set of three-dimensional 'before and after' imaginary scenes in the life of a tenant family, based on careful research (Artist, Elizabeth Odling).

Once work on the exhibition got under way we began to be flooded with generous loans and gifts from local people. These were difficult to integrate in the main exhibition on account of their later date, but were nonetheless fascinating. They have been housed in a separate bay at the end of the loft where more can be added at any time.

Material which is better read (e.g., the eighteenth century Statistical Account of the Parish) has been made into scrapbooks through which the interested visitor can browse. Copies of all Adam's surviving drawings of Culzean have been collected together, possibly for the first time, in one of these scrapbooks.

The information room is located below the loft. Here photographs of those who now keep the place going (foresters, gardeners, housecleaners) give some idea of what is involved in running the Park now and perhaps of how soon it would disintegrate without them. A park ranger (often a student on vacation) is there to answer questions and there is a big model of the Park.

The restaurant is self-service. The oak furniture was designed by the architect to be bold enough in scale and in character with the Adam farm buildings. Round tables with chairs seat six; rectangular tables with benches seat eight to ten. These can be used indoors or out; half-a-dozen are permanently in the courtyard in the summer. We were advised that the public would not like sharing tables but this worked well. The restaurant is hired for private functions in the evenings and also hired in conjunction with the auditorium.

The Trust paid for the conversion of its new shop which also opens into the courtyard (there is another in the Castle). Both are popular with schools as well as adults and in 1975 had a net profit of £12,000.

The house continues to be lived in by a family which worked for many years on the farm. Their beautifully tended garden is one of the first things the visitor sees and it sets a tone for the Park as a whole.

The courtyard is covered with a local gravel, Quartsag, whose soft ochre color sets off the honey-colored sandstone. Granite paving blocks are used for trim and drainage channels and there is paving immediately outside doors.

The center of the yard was originally a midden. It now needs some focal point, both visually and to provide a place where visitors, particularly children, can sit and congregate. The original scheme included a low stone platform with steps up to it and we hope that money will be forthcoming for this.

Litter containers were obviously necessary but it was difficult to

think of anything which would not be obtrusive. Chestnut hogsheads with trash cans inside have been used. They look like rainwater collectors but fortunately their purpose is recognized. Seats are plain plank benches. Picnic tables (out of character with Adam) are not close to the buildings. A fallen tree and farm wagon are provided for climbing children. Signs and printed matter throughout the Park are carefully related. Signs have been avoided wherever possible.

Car parking has been limited to what was considered to be the capacity of the buildings in terms of people: a hundred cars and eight buses (more buses and fewer cars during May and June, peak school periods). This is a rather rough assessment since people may park elsewhere and walk to the Park Center but the reverse is also true. Parking was first planned a couple of hundred yards from the Center buildings but it was realized that it would be much less conspicuous and more convenient if concentrated close to them in the angle between the two wings where a service yard for the kitchen was needed. The scale and visual impact of the hard surfacing is reduced by using tarred macadam for the roadways and chippings for the parking bays which are marked by lengths of timber. The main car park is planted formally with lines of rowan trees, like an orchard, and the whole is screened by newly planted hardwoods. In ten years the plantings will look very different.

Capital investment: In the first six years (1970-1976) nearly £384,000 was spent on capital projects, including the £258,000 spent on the conversion of the Home Farm; the remainder went on such things as roads, car parks and ranger services. The money for this has been met 75 per cent by the government, through the Countryside (Scotland) Act 1967, and 25 per cent shared equally between the local authorities. In terms of visitors to the Park since it opened (about 1¼ million), this worked out at 30 pence per head.

Annual running costs: Parking charges, together with the income from rents, forestry, etc. offset about 40 percent of the gross annual deficit, which is met by local authorities, now four in number under the recent reorganization. With visitors numbering 300,000 this meant that they cost the local authorities about 16p a visitor. The Park Center is wearing well under this intense use. Such a robust building is likely to need much less maintenance than any prefabricated alternative.

Elisabeth Beazley is an architectural consultant and author who works on the problems of tourism and conservation. She has been Consultant to Culzean Country Park since 1969.

The Editors are grateful to the National Trust for permission to use this article. It is based on a longer version in The National Trust Yearbook, 1976-77, Europa Publications, Ltd.

Andrew Allo

The Garoua College of Wildlife Management

It was in the mid-1960s that the basically French-speaking West and Central African States became increasingly aware of the important role of wildlife in the economic development of certain countries such as Kenya, Uganda and Tanzania and the role it could play in their individual economies. The countries became equally aware of the impact of poaching and other forms of exploitation and land-use on wildlife and its habitats. The African Convention, signed by the Organization of African Unity (OAU) heads of state in Algiers in September 1968, was a landmark in the same direction and no wonder several nations have set aside numerous and important portions of their territories as national parks and game reserves. However, these parks and reserves needed the trained manpower required for their protection and management.

Creation and Achievement

The Garoua Wildlife Management College (Ecole de Faune) was created in the late '60s to fulfill the need for lower and medium-grade personnel in the French-speaking African states. The College started in 1970 with 18 students from five countries and has already trained 252 personnel from 18 different countries. Ever since the yearly intake and the number of countries interested in the school have steadily increased. During the 1976/1977 school year, Garoua attained full capacity of 52 students originating from 14 different countries.

Priorities in the Training Program

In 1970 only seven courses were taught at the school, namely: Biology, Wildlife Management Techniques, Ecology, Auto-mechanics, Veterinary Techniques, Fire-arms and Legislation. Since 1971 the program has been modified considerably and now includes 13 different subjects divided into three categories: biological, technical and general.

1. Biological
   a) Biology and Natural History
   b) Ornithology and Taxidermy
   c) Veterinary Techniques
   d) Principles of Ecology
   e) Range Management
   f) Wildlife Management Techniques
   g) Zoo Management

2. Technical
   a) Introduction to Motor Mechanics
   b) Survey and Photography
   c) National Parks Management
   d) Fire-arms
3. General
   a) Principles of Economics and Economic Utilization of Wildlife
   b) Wildlife Legislation and General Administration

English language has also become compulsory for the Diploma course students. This is so because about 80 percent of any useful information on Ecology, Wildlife and Range Management is in English and the students need some knowledge of the language in order to be able to take advantage of our library facilities.

Emphasis has been progressively laid on the practical side of our training program. About one third of the school year is spent in the field in the national parks of the Cameroon and Nigeria and a considerable amount of time is spent in a 370,500-acre (149,939 ha) biological reserve attached to the school and situated just some 50 miles (80 km) south of Garoua. Field work usually includes: game and bird watching; study of distribution patterns; condition and reproduction of animals; collecting and determination of botanical samples; establishment of permanent plots for vegetational studies; game counts; anti-poaching exercises; and game control, etc.

Follow-up of Graduates

A follow-up program was initiated in 1974 when Mr. Dubreuil (then the Director of the School) and I visited Chad, Central African Republic, Congo and Gabon. In 1975 we traveled to Zaire, Ruanda and Burundi. In 1976, I visited Togo, Benin, Ivory Coast, and Senegal, and in June 1977 I went to Niger, Mali, Volta, Morocco, Senegal and Ghana.

The objectives assigned to the follow-up program are basically to keep the authorities of the various countries that send students to the school well informed and to evaluate the effectiveness of our graduates, their problems and the opinions of their directors as to the value of the Garoua training and as to how we could prepare their students any better. We also try to evaluate the needs of the countries concerned from 1977-1981 and advise them on available financial sources for scholarships. Where possible, we interview prospective students and advise their directors as to the aptitude of candidates who would profit from our training program.

The Future of the School

After seven years of training it became more evident that the one-year training duration was inadequate and any serious and more effective training would require at least two years. After receiving the opinions of those that employ our graduates, the Cameroon Government has now prolonged the duration from one to two years beginning in September 1977. The advantages of this change are that we will be able to give a better program and our diplomas will certainly be taken into consideration in the reclassification of our trainees. However, it has its one disadvantage and that is, the present scheme cuts down on our output. Whereas we previously graduated one set of students every year, we will now have to handle two streams of students and our installations are inadequate at present. However, given the increasing demand, we hope to be able to get a better selection of candidates. It is hoped that the school will someday become attached to the National University.

A Garoua class group studies use of portable two-way radios to combat poaching.

Research

Other activities of the school have included basic research necessary to improve the teaching program. Ecological research includes the vegetation and wildlife distribution patterns in some of the Cameroon National Parks, the ecology of the Buffon kob, fire ecology, and the application of various censusing methods to the savann woodlands of West and Central Africa.

Conclusion

Considerable assistance has been received from the U.N. Food and Agricultural Organization, the German Government, the French Government, World Wildlife Fund, Frankfurt Zoological Society, European Economic Community, Rockefeller Brothers Fund and the African Wildlife Leadership Foundation, all of which have enabled the school to be what it is and to them I register our gratitude.

Andrew Allo, now Director of Garoua College, joined the staff as co-director in 1971. He graduated from Mweka College of African Wildlife Management in 1967, and then under the sponsorship of the African Wildlife Leadership Foundation continued his education in the United States, receiving his B.Sc. and M.Sc. degrees at Humboldt State College and the University of California, Davis.

This report is reprinted from the spring 1978 issue of the African Wildlife Leadership Foundation's "Wildlife News," Nairobi, Kenya.

Canada's Proposed Arctic National Wilderness Parks and National Landmark

Six spectacular wilderness areas in the Canadian Arctic, embracing an estimated total of at least 89,500 km², have been proposed for inclusion in the Parks Canada System. Five are proposed as National Wilderness Parks and one is a small natural site which could become Canada's first National Landmark.

Extensive public discussions throughout the region have been in progress since last January, and will continue until all interested parties have been heard.

Protection of traditional rights of Indian and Inuit people who have used the land for hunting, fishing and trapping are implicit in the proposals.

The six areas, located on the map accompanying this article, are described as follows:

Banks Island

The proposed National Wilderness Park on Banks Island, which is located 483 km northeast of Inuvik, stands at the northern end of the Island and includes a portion of the Thomsen River Basin, the Musk Ox River, and Mercy and Castel Bays. A southern component featuring Nelson Head is being considered.

The lower Thomsen River basin is considered the most productive muskox range in the world with 4,000 to 5,000 animals. Arctic fox are numerous in the finest arctic fox range in Canada. Beluga whales have been reported off the coast of Castel and Mercy Bays, and ringed and bearded seals are present. The area is used by the Banks Island caribou herds in late summer and fall.

The lower stretches of the river are a significant moulting and staging area for brant and snow geese. A designated Migratory Bird Sanctuary, the area is also the breeding ground for the peregrine falcon, gyrfalcon, and rough legged hawk.

The proposed park consists of three topographical units: a deeply dissected plateau of Devonian age to the east, the Thomsen River Valley lowlands in the center and to the west a dissected upland of Cretaceous age.

Archaeological evidence unearthed near the confluence of the Thomsen and Musk Ox River indicate that the Island has been intermittently occupied by Inuit for more than 3,000 years.

Wager Bay

This proposed National Wilderness Park is on the northwest of Hudson Bay in the Northwest Territories. The area is unusual for its diversity of arctic land and sea mammals, some of which remain in the immediate vicinity year round. Caribou and polar bears are both present.

The waters of the Bay are frequented by the beluga whale and narwhal, as well as ringed, bearded and ranger seals. Historical records indicate the area was at one time home to the muskoxen. The establishment of a National Wilderness Park would facilitate the reintroduction of this species to its former habitat, and provide much needed protection while they regain their former abundance.

Current wildlife surveys indicate that Wager Bay may be one of the Arctic's more productive areas for peregrine falcons, gyrfalcons and rough-legged hawks.

The history of the Inuit people of Wager Bay is believed to date back more than 4,000 years.

The landscape of Wager Bay is characteristic of the Canadian Shield. The reversing falls between Wager Bay and Ford Lake is one of three such phenomena in Canada. The reversing falls and a tidal bore at the mouth of the Bay create polynias, areas free from ice year-round.

Northern Yukon Territory

This proposed National Wilderness Park includes the entire Firth River and its watershed, the Babbage River, the Old Crow Flats, the British Mountains, the Yukon Coast, Herschel Island and a marine component in the Beaufort Sea. Its boundaries are to be established within a 38,700 km² area of land in the Northern Yukon withdrawn by Order in Council from further alienation (new development), in July 1978, for National Park and other conservation purposes.

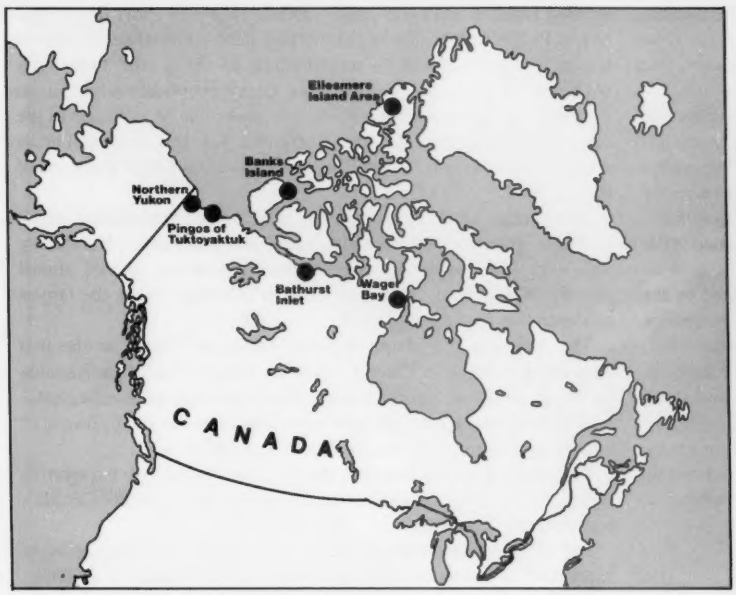
The area is a superlative wildlife habitat. North America's three bear species, the grizzly, the black and the endangered polar bear are all found within the proposed boundaries. The area is considered to be among the finest raptor habitats in the Arctic, with the Golden eagle, rough-legged hawk, bald eagle, osprey, gyrfalcon and peregrine falcon present. Moose, Dall's sheep and wolves are also found.

The Old Crow Flats, a level basin rimmed by mountains and dotted by hundreds of lakes, is a major North American waterfowl area as well as an important migration route for the Porcupine herd of barren-ground caribou. Each spring this herd, with numbers ranging between 70,000 and 140,000 animals, migrates from its wintering range in the Yukon interior to its calving area in the Northern Yukon and Alaska.

In spring bowhead and beluga whales migrate into the Beaufort Sea from the North Pacific. The bowhead whale, once near extinction, is occasionally sighted.

Herschel Island, the Yukon's only island, is of considerable biological interest. More than 100 plant species have been collected and at least 17 major plant communities are present. The island is thought to have been created by the force of glacial ice, which gouged marine sediments from the sea.

Protected by a surrounding rim of mountains from the ice which changed the topography of much of North America during the ice ages, the area is the only extensive non-glaciated landscape in Canada. It is perhaps the only area in Canada where Arctic tundra, alpine tundra and boreal forest can be seen in their natural condition in the same location.



Pingos — low hills containing massive ice cores — are one of nature's most curious phenomena. More than 1000 of these fragile hills protrude from the tundra in the Canadian North. Most are located in the Tuktoyaktuk Peninsula.

The area was a refuge for flora and fauna during glaciation, and has archaeological and paleontological evidence of international significance. In 1976, an archaeological dig unearthed what is believed to be one of the oldest human remains ever discovered in the western hemisphere, and studies indicate that man was in this area more than 30,000 years ago. The area is also important for the study of prehistoric ecosystems. The site of Engigstciak on the Yukon Coastal Plain is considered to be one of the most important Inuit archaeological sites thus far discovered in the western Arctic.

Ellesmere Island

The proposed National Wilderness Park, which comprises northern Ellesmere Island and a portion of Axel Heiberg Island, includes Cape Columbia (83° 07′ N), Canada's most northerly point of land. The area is characterized by three major physiographic units — the Grant Land Mountains, the Lake Hazen Plateau on Ellesmere Island and Mokka Fiord Uplands on Axel Heiberg Island.

The Grant Land Mountains consist of three ranges, one of which features Mount Barbeau, 2.604 m, the highest peak in eastern North America. The Hazen Plateau is generally flat in appearance and consists of strongly folded sediments, a few streams and a few minor ice caps. The Mokka Fiord Uplands offer an extremely varied topography, ranging from a highly dissected highland area to a rolling coastal plain.

Several hundred glaciers, varying in size from major trunk glaciers up to 40 kilometers in length to simple glacier tongues, are located within the proposed area. Ice caps covering the mountains in northern Ellesmere Island are believed to be remnants of an ice cap which may have once covered the entire Island. The area also features massive ice shelves which lie off the northern coast, and is the only place in the northern hemisphere where they occur.

Despite a very severe environment, there are pockets of sheltered and well-watered areas where vegetation flourishes and animals thrive. Examples of these habitats are included in the proposed park reserve. Arctic hare thrive in large numbers both on the Ellesmere and Axel Heiberg Islands. Muskoxen, Peary caribou, polar wolves and Arctic fox can be found and about 30 species of birds are known to breed in the region.

Lake Hazen, the world's largest lake north of the Arctic Circle, is one of the richest wildlife areas in the High Arctic. The proposed National Wilderness Park, which faces the new Northeast Greenland National Park across the Robeson Channel, would protect several examples of plant and animal communities remarkable for such a northerly latitude.

Paleo Eskimos once followed migrating herds of muskoxen, on which they depended for food, from the Canadian Arctic to Greenland. A long stretch of this prehistoric route, called the Musk Ox Way, has been included in the proposed park reserve. Excavations in Peary Land in Greenland have unearthed a number of Eskimo sites which are more than 4,000 years old.

During the late 19th century, three exploratory expeditions travelling through the area stopped at Fort Conger, on the northeast coast of Ellesmere Island. This site was first used by Captain G. S. Nares and his crew in 1875 and was subsequently visited by Lieutenant A. W. Greely in 1881 and Lieutenant R. E. Peary in 1898. Fort Conger is a significant historical site worthy of preservation and has been included in the proposed national park.

Bathurst Inlet

The proposed National Wilderness Park surrounding Bathurst Inlet, located in the Northwest Territories, is remarkable for its diverse and luxuriant vegetation which thrives in sheltered locations along the inlet. This provides habitat for large numbers of tundra mammals such as barren-ground caribou, muskox, Arctic fox, and Arctic hare; birdlife is also abundant.

The Inlet is a critical breeding ground for the peregrine falcon, a rare and endangered species. Recent estimates suggest that the area has the largest and healthiest population of peregrine falcons in the world.

The Bathurst Caribou herd, numbering about 200,000, is the largest herd in Canada. Each spring the caribou pass through the southern end of the Inlet on their way to calving grounds located on the uplands east of the inlet.

The proposed park also contains two other critical wildlife habitats: the muskox range and the staging grounds for migratory waterfowl. The muskoxen were once abundant around the inlet, especially in the northwest where they are now very scarce. Elsewhere the population is recovering and it is estimated that there are four to five

hundred muskoxen in the area. About fifty species of birds frequent the inlet which is an important staging area for Canada geese, snow geese and white-fronted geese. The inlet is also one of the few places in the Arctic where the rare northern wolffish is known to occur.

In addition to being an outstanding habitat for wildlife, the inlet also offers spectacular scenery. Awesome gorges, rapids and waterfalls border the inlet and there are innumerable lakes and streams sprinkled throughout the area. Wilberforce Falls (48.77 m) is thought to be the highest falls in the world north of the Arctic Circle. Other major waterfalls and islands with impressive scenic features are located in the area.

The first European explorers found Bathurst Inlet inhabited by the Copper Eskimos, a loose association of local groups. Two groups known to frequent the Inlet in the spring were Umingmaktormuit, "people of the muskox," and the Kiluhuktormuit, "people of Bathurst Inlet." Although there has not been an extensive archaeological study done on the Inlet, many sites and artifacts have been found including stone blinds, tent rings and fishing weirs. Banks Peninsula, for example, has many signs of more permanent human occupancy which can be further studied and may reveal the lifestyles of the original inhabitants.

Pingos of Tuktoyaktuk

This proposed National Landmark site is located 2,200 km northwest of Edmonton, Alberta and 6 km south-southwest of the village of Tuktoyaktuk in the Northwest Territories. The area contains Ibyuk Hill, the largest pingo in Canada.

Pingos are low hills that protrude conspicuously from the rolling, lake-dotted tundra of the Tuktoyaktuk Peninsula. Containing massive ice cores, pingos are one of nature's most curious phenomena. A striking aspect is their life cycle which is relatively short in geologic terms. Pingos form in lake beds in areas of permafrost when the thermal regime of lakes is altered by natural processes. They grow to maturity over several thousands of years and decay eventually when pingo summits are ruptured and their ice core melts due to exposure to the sun. They are important habitat for Arctic fox and other mammals which choose the hills for their dens and also birds which make use of them as well.

Some pingos are dome shaped, others flat topped or elongated. Some resemble volcanos, complete with craters and water lakes. Numbering well over 1,000 in the Canadian North, pingos are located almost entirely in the Tuktoyaktuk Peninsula. It is thought to be the largest concentration in the world.

The creation of a pingo National Landmark would be the first National Landmark in Canada. With the introduction of its National Landmark program, Parks Canada plans to preserve outstanding natural features that warrant recognition but which are too small, fragile or limited in their range to qualify as national parks.

Due to its extreme fragility, the great scientific and interpretive values, the pingo area is a suitable candidate to become Parks Canada's first National Landmark.

The six proposals outlined above are among the many areas of impressive natural value which are being studied for possible inclusion in the Parks Canada System. They are representative of major natural environments. In the words of the Government, "identification and protection of these areas cannot await or accommodate the advance of competing land uses. Action is required while the opportunity exists if the heritage of the past is to be passed on to the future."

This article was prepared by the National Parks Branch, Parks Canada.

Sylvanus Gorio

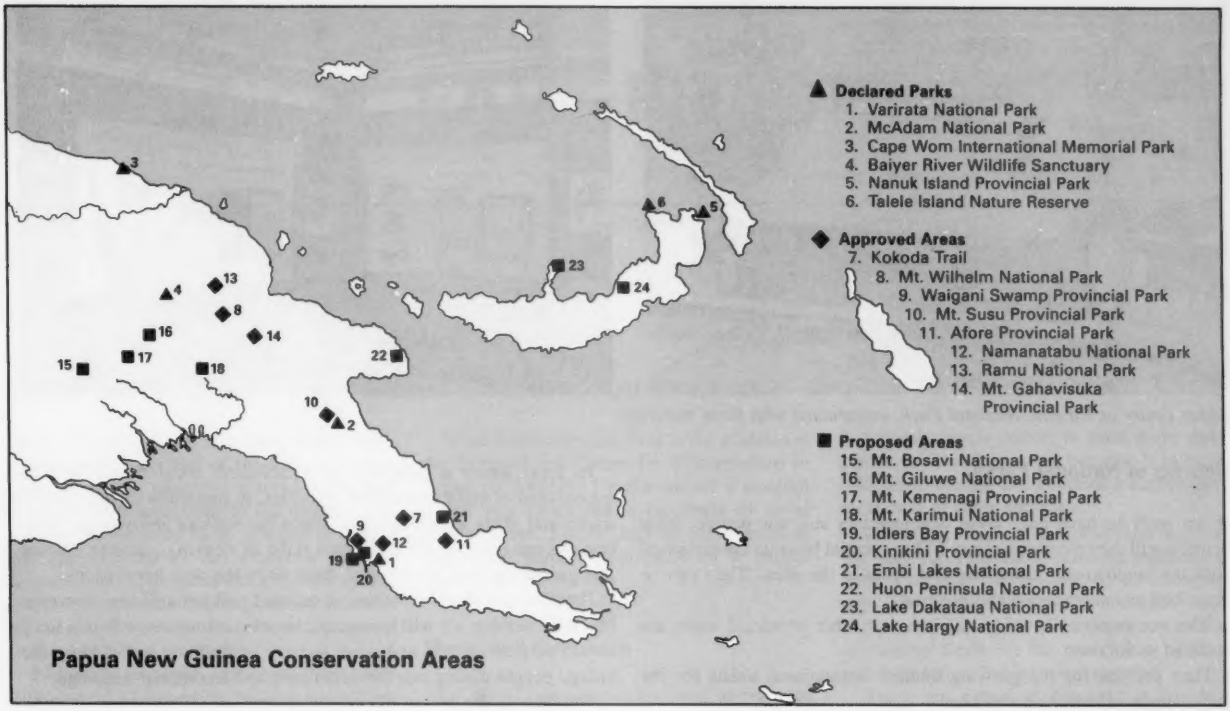
Papua New Guinea Involves Its People in National Park Development

An outsider who flies over the wilderness area of Papua New Guinea might wonder why a country like this would need national parks. The rationale, however, is simple. It is rooted in a clear understanding of the fact that parks and reserves can play a significant role in the development of the country. Much of our country's natural and cultural resources are still untouched. If these resources are identified, protected and developed properly, a significant portion will remain in its natural state for the benefit of present and future generations, free from uncontrolled changes and damaging development.

The idea of having national parks here originated in the visit of a Papua New Guinean, Mr. Dirona Abe, to the Yellowstone National Park in 1966. He again visited Yellowstone and Grand Teton National Parks in 1972, on this occasion as Chairman, National Parks Board, when he attended the Second World Conference on National Parks. This experience reaffirmed and strengthened his convictions that national parks are of special importance to countries whose natural resources are still largely untouched by development.

Little was known in Papua New Guinea about the national parks concept until 1970 when work began on the first national park, Varirata. Today the concept has spread into many areas in our country as a result of work by the National Parks Board.

A major impetus came when Mr. Neville Gare of Australia was seconded to the Papua New Guinea Park Service. He worked hard to achieve Varirata, and in the process he helped to establish the basic policies on land acquisition, planning, and management that have proved to be so sound and so successful throughout our entire effort. When Varirata was officially opened to the public, it reflected the image of a national park to a great many Papua New Guineans.


Declared Parks
1. Varirata National Park
2. McAdam National Park
3. Cape Wom International Memorial Park
4. Baiyer River Wildlife Sanctuary
5. Nanuk Island Provincial Park
6. Talele Island Nature Reserve
Approved Areas
7. Kokoda Trail
8. Mt. Wilhelm National Park
9. Waigani Swamp Provincial Park
10. Mt. Susu Provincial Park
11. Afore Provincial Park
12. Namanatabu National Park
13. Ramu National Park
14. Mt. Gahavisuka Provincial Park
Proposed Areas
15. Mt. Bosavi National Park
16. Mt. Giluwe National Park
17. Mt. Kemenagi Provincial Park
18. Mt. Karimui National Park
19. Idlers Bay Provincial Park
20. Kinikini Provincial Park
21. Embi Lakes National Park
22. Huon Peninsula National Park
23. Lake Dakataua National Park
24. Lake Hargy National Park
Papua New Guinea Conservation Areas

Publicity has been very important, especially through the press and radio, as have been visits by officials made to schools and to the communities. At the Baiyer River Sanctuary we have encouraged the school children to visit the Sanctuary during the term holidays.

A further extension of the education program has been handled by the Rangers and the Investigation Officers who, during their visits to the people, discuss park concepts and their benefits. Then the village elders are encouraged to visit the already existing national parks to give them a broad outlook of a national park.

The Board is now developing and managing six declared parks, all of which have been established on Government land. They are Varirata National Park, McAdam National Park, Nanuk Island Provincial Park, Talele Islands Nature Reserve, Cape Wom International Memorial Park and Baiyer River Wildlife Sanctuary.

Of the six areas four are staffed and are easily accessible. Varirata National Park is fairly well developed with a Welcome House, recreational facilities and well-defined walking tracks. It has also served as a model for development of other parks.

Cape Wom International Memorial Park is a Historic Site, recognized throughout the world as the site of surrender of the last major Japanese land force to the Australians in 1945. Picnic facilities are available in the area for recreational purposes.

Baiyer River Wildlife Sanctuary is located in the Central Highlands. It maintains in captivity a variety of species of Birds of Paradise and other Papua New Guinea wildlife in a rainforest setting. The Sanctuary also has a recreational area for day visitors and a lodge for overnight users.

Development has only begun in the McAdam National Park. There are no picnic facilities as yet but it provides an ideal place for the keen bushwalkers.

The other areas named above as yet are relatively little used and are protected by caretakers rather than rangers. These will be up-graded as the need occurs. Also, park visitors will find that most buildings in the parks are of local design and constructed of local materials to harmonize with their natural surroundings.

Establishing national parks, or any other form of land use on lands that are not owned by the Government, presents unusual problems due to our complex land tenure system. If the land is Government owned, we can proceed to negotiate with the appropriate authorities until the area is finally gazetted.

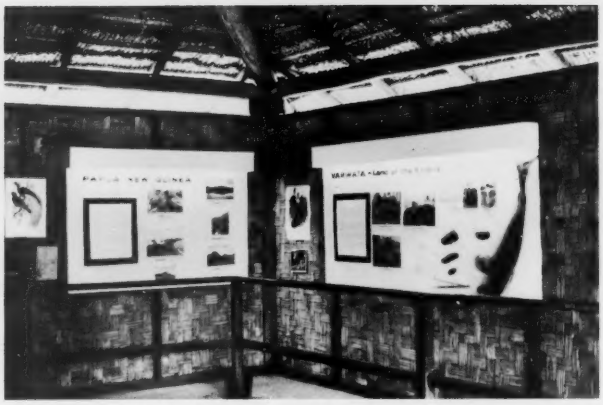
However, if the land is under private or community ownership the procedure is much more elaborate.

The land tenure system varies throughout the country. Land may be under private ownership in one area, while in another it is under multiple or clan ownership, of either the mother's or father's side of a family, depending on the part of the country. One vital aspect of area selection is that each area selected must be meaningful to the people. Therefore an understanding of the peoples' values and rights to their land is crucial. To establish a park or other Government use on land not owned by the Government, we *must* negotiate with the right land owners and come to a compromise before any form of development begins. It is important that the final decision come from the local people and not the Government, unless the land is Government-owned.

When all the facts about a new park are known, it is then up to the people to decide the issue. If the result is negative, we do not attempt to force the concept on them. If we do, future reactions in other areas may also be negative.

But if they agree to have a park established on their land, then negotiations can go ahead, taking into account and respecting their traditional interests and rights in the area.

To help promote a nationwide understanding of potential national park values and to protect the cultural traditions involved, the National Parks Board recruits young men from all parts of the country to serve as Park Rangers. These rangers are later appointed as Provincial Rangers in their own Provinces when national parks are established there. This practice is clearly to the advantage of both the Board and the local people because these rangers are familiar with the local customs and are best able to communicate with the people. As a result of these policies the national parks concept is gradually gaining support in the villages throughout the country.



Visitor center at Varirata National Park, constructed with local materials.

Benefits of National Parks

If we work to have park areas developed to suit our people, what benefits will they receive in return? The potential benefits are discussed with the landowners during the first visits to the area. They can be described as *non-material* and *material*.

The non-material benefits of parks and other protected areas are outlined as follows:

- They provide for the growing outdoor recreational needs for the increasingly urbanized population.
- They provide attractive natural settings within which overseas tourists can appreciate local scenery, vegetation, wildlife, history and culture.
- They provide scientific reference areas in which changes due to forestry and agricultural monocultures, industrial works and other large scale developments and environmental disturbances can be monitored, identified and measured.
- They provide gene-pools of the widest possible range of types of plants, animals and other organisms, many of which may be essential for the well-being of future Papua New Guineans.
- They provide areas for protection of traditional cultures. This is especially important to people who are undergoing rapid changes in their life styles.

Material benefits will go to the customary owners of land on which the national parks are established and to others in the area. These include:

- Availability of paid employment at home.
- Possibility of group involvement on a remunerative contract basis.
- Income from the provision of required services to people using the park.
- Income from sales of artifacts, crafts and produce to park visitors.

In areas where a park will be established, local people will be encouraged to maintain cultural activities, in particular the practice of traditional skills within the park where the visitors and younger generations can observe and learn such skills as weaving, carving, fishing and gardening, and in turn pass them on to the next generations.

Practice of cultural activities in national parks is still low; however this is something we will encourage later on. However it is practiced extensively in schools and other tertiary institutions and also by the village people during ceremonies, feasts and traditional dancings.

Our people are aware of the importance of conservation through national parks, particularly in relation to cultural conservation. Most of our people are concerned about our customs and traditions and are fully aware of the impact civilization has had on them. We believe this concern will go a long way toward assuring support of efforts to safeguard, in future, our great wealth of natural beauty, cultural traditions, and resources of scientific value.

If we continue to protect and manage our parks as we are today, and train many more Papua New Guineans so conservation programs may expand, then tourism from abroad can be encouraged and thus strengthen our economy.

Finally we hope that young developing countries like ours, whose people also are closely linked to their land and cultural resources, will study and benefit from our experience as an approach to park development and management.

Sylvanus Gorio is Executive Director of the National Parks Board of Papua New Guinea. He was born in Papua New Guinea and is a graduate of Bulolo Forestry College there. He became the first Park Ranger in 1969, and after several short courses on National Parks overseas, he was appointed Executive Director in 1976.

PARK PRACTICE

Stone Deterioration and Related Conservation Problems

Giorgio Torraca

The progressive decay of buildings and monuments which are part of the culture of past generations was taken for granted in the past but is far less acceptable to the modern sensitivity; we feel even more so today after having been alerted by the evidence that the spreading of an advanced technical society may result in an acceleration of the deterioration of ancient materials when they become exposed to a modified environment.

In current language, stone was often taken as a symbol of durability but this is far from being true in any environment; the notion of stone decay, and prescriptions for its protection, are found for instance in the Latin writers of the classic age.

Actually stone deterioration is part of a natural cycle which includes the formation of rocks and their successive disintegration under the action of the atmosphere.

As the products resulting from the weathering of rocks are the inorganic components of soils (clay, silt, sand, gravel), the cycle is essential for the development of life on the earth; we cannot regard it as a pure nuisance.

When stones are used in buildings or in works of art, the natural cycle is modified by the introduction of quarrying and carving operations. However this does not change it in an essential way, even if cracks induced on the surface of stone may accelerate the deterioration processes; stone is unstable if directly exposed to the atmosphere and will deteriorate sooner or later.

Between the sooner and the later there may be, however, a difference of centuries; so there is ample room for improvement, and this should be obtained by applying scientific methods to the investigation of the deterioration processes and by trying to interfere with them in such a way as to reduce their rate of development.

Stone deterioration processes are rather well known today, even if some details still need to be worked out in a more precise way. It is not easy, however, to offer a comprehensive and simple description of such processes because the factors influencing them are numerous and the relevant data are usually collected and discussed by scientists belonging to various disciplines, such as Climatology, Geology, Chemistry, Mechanics, etc.

When explaining this field to the students at the International Centre for Conservation in Rome (ICCROM) I make use of a concept which was developed in the study of metal corrosion but, I think, may be quite useful in explaining stone deterioration in a unified way.

Stress and Corrosion

The term *stress-corrosion* was introduced years ago to describe the deep corrosion of iron bars submitted simultaneously to a mechanical stress and to an aggressive environment. It may be applied to stone to define in the most general way processes of deterioration which evolve at an unusually high rate and may be regarded as pathologic. The use of this term implies the recognition that those processes are originated by the superposition of chemical processes (corrosion) on mechanical forces acting on the stone (stress).

Corrosion is essentially due to water which can attack and decompose some minerals present in several types of stone. An example is offered by feldspar and chlorites which are silicates found in many rocks (sandstones for instance). They are slowly decomposed by water and form mechanically weak minerals (clays) which occupy a larger volume than the original ones.

Atmospheric water (i.e., rain or dew) may also dissolve some gases which are transformed into acids by reaction with water, and cause an increase of chemical activity. In this way carbon dioxide forms carbonic acid (a weak acid),and sulphur dioxide, after addition of oxygen, forms sulphuric acid (a strong acid).

The carbonates of calcium and magnesium which are important constituents of many rocks (marble, limestone and some sandstones) are attacked by acid water and transformed into soluble products (salts). It is important to note that soluble salts may themselves become the cause of further trouble.

Rainwater may become acid, particularly in urban areas, and cause increased rates of erosion; but water is also active on stone in the form of condensation, i.e., the dew deposited on cold surfaces in damp nights.

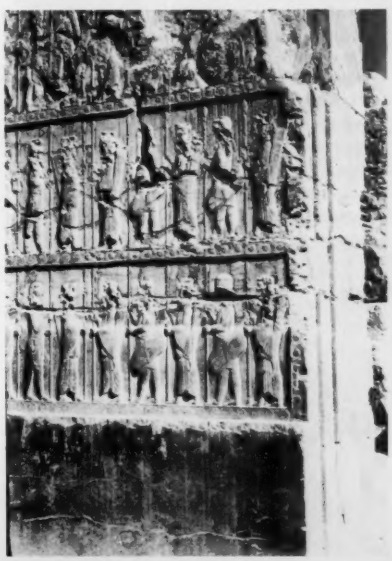
Actually condensation is even more dangerous for stone than rain because it is more difficult to control and contains a higher concentration of acids and salts.

Stress may arise in stone for several reasons. We may call *external stresses* all mechanical actions imposed on the stone by its surroundings; for instance the load that a stone must carry in a building. Another important source of external stress are the movements of thermal expansion, if they are restrained.

There are situations, however, in which a force acts from inside the stone and tends to burst its surface open. Such *internal stresses* arise because stones are porous and water can gain access to their interior through a network of cracks or channels of all possible sizes.

A typical internal stress situation arises when water freezes inside a porous material.

Isphahan (Iran). The upper section of the limestone base of the Apadana was exposed to atmospheric agents for centuries. The lower part of the first line of figures was excavated only 50 years ago. The damage caused by thermal expansion and water action is dramatically shown by the contrast with the condition of the recently excavated section.



In this case crystals of ice grow only in the largest internal spaces available, as too much energy is required to make them grow in the microscopic pores. If liquid water is still available when the largest spaces are full, the crystals begin to push against the confining walls as they tend to continue their growth.

A similar process leads to important internal stresses when crystals of soluble salts are formed inside a porous material. This can happen when water containing dissolved materials gains access to a porous material and then evaporates.

Mechanical stress is important in stone deterioration because stone is a hard and brittle material. Metals behave much better than stone under stress because they are hard but also plastic (i.e., they can be deformed). A metal can adapt itself to the particular force acting on it by changing its shape and achieving a more even distribution of the stress in its new form.

Stone, which is not able to redistribute stress by deformation, cracks easily along the section that is subject to the strongest mechanical action. All rigid, brittle materials contain cracks, particularly on the surfaces that were subjected to strong mechanical actions during their working.

Superficial cracks are dangerous not only because water can enter them but also because further stress applied to the material for any reason becomes concentrated, and magnified, at the end of the crack. The consequence of this is that a crack propagates easily in a rigid material; everybody knows for instance that it is far easier to break a piece of wood if a notch is made in it on one side.

Biological factors

For a complete description of stone deterioration, *biological factors* should also be considered: algae, lichens, molds and bacteria contribute to the physical and chemical processes described above by means of the secretion of acids synthesized from available gases or salts.

Borobudur (Java, Indonesia). Biological deterioration of Andesitic stone is caused by lichens and algae. However, dangerous white efflorescences of silica and calcite are due to soluble materials liberated by cement used in the restoration carried out at the beginning of the century.

In general, however, it looks like the biological agents are able to colonize a rock surface only after a previous chemical-mechanical process has created conditions that are favorable for the biological attack.

In other words biological processes seldom may be considered as the main factor in those rapid deterioration processes which may be defined as pathological.

All these deterioration processes are in themselves rather simple but real cases are instead always more complicated because usually more than one process is involved and their interplay is not immediately detectable.

A further element of diversification is constituted by the great differences existing between the various types of rocks; besides the chemical composition, other factors which determine the type and rate of the deterioration process are the shape, the size and the number of pores, or cracks, existing in each particular stone.

To speak in general of a "stone disease" covering all types of deterioration has no meaning whatsoever. There are instead many "diseases," just as in the case of man, depending upon the aggressive agent (or combination thereof) and the constitution of the individual affected.

As a consequence the attitude to be taken in planning a conservation policy must be similar to that prevailing in modern medical science, that is to identify and describe diseases, to attempt remedies in order to modify their evolution in a favorable way and finally to check all effects of the action taken.

The failure of several stone conservation techniques was due in the past to the lack of appreciation of the general schemes discussed above and to the insufficient analysis of the individual cases that were treated.

It is necessary, however, to come out of the vague general statements to which one is confined if all cases are considered together. I think that the best way to allow the nonspecialist to understand the modern attitude towards stone deterioration is to describe in detail two "diseases" that are widespread and rather well studied.

The *deterioration of white marble* is strongly influenced by the peculiar structure of this material which is formed in nature by the metamorphosis of limestone. Under heat and pressure, at great depths, the tiny shells of small animals or the precipitated grains of calcareous material (which are still visible in limestone) are transformed into large crystals of calcite. These large crystals are perfectly visible by the naked eye and are the cause of the shining whiteness of the material; they are also responsible, however, for its frailty in an aggressive environment.

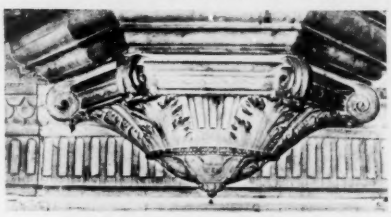
White marble is almost nonporous as it exists in the core of the rock, but already the quarrying and carving processes cause the formation of cracks on its surface. When a marble piece is subject to temperature variations its porosity progressively increases because the large crystals of calcite expand, when heated, in one direction (the main axis of the crystal) but contract along the transversal ones. The result is that, in the course of the life of a piece of marble on the surface of the earth, the crystals may be frequently pushed one against the other or, to the contrary, may tend to separate from one another.

The second weak point of calcite crystals is that they break quite easily along preferential directions which correspond to the faces of a rhombohedron (the technical term for this phenomenon is "cleavage"). Under the stresses caused by the thermal expansion and contraction, in any piece of marble some crystals are cleaved and others are detached from their neighbors. A network of cracks is created in the material and continuously grows with its age of exposure.

Access of water to this internal network causes internal stress, because of frost or crystallization, and further deterioration. If the water is acid, chemical corrosion also takes place as calcium carbonate is dissolved along the roads of penetration and transformed into calcium sulphate. If the surface of the marble is directly exposed to the rain, the corrosion products are washed out and the material is progressively eroded.

If the marble surface is sheltered from the washing action of rainwater, an even more dangerous process may take place because of condensation. Condensation water, which is laden with acids, and salts in polluted atmospheres, enters the network of cracks exerting a corrosive action. The wetting phase is followed always by a drying one in which the condensed water evaporates leaving on the surface the soluble salts that it contained initially, plus the ones formed in the corrosion process.

The result of condensation is that on the surface a crust is formed which is dark in



Venice (Italy). In the church of Santa Maria dei Miracoli, the 15th C ntury marble pulpit on the south side of the building shows the delicate carving still intact.

In the same church the carving on the pulpit of the north side is completely destroyed showing the depth and velocity of destruction caused by condensation in the presence of air pollution, even inside a building.

color, because it contains dust or smoke, and is mainly composed of calcium sulphate (gypsum).

Under the dark crust the marble is progressively disintegrated by the wetting-drying process described above up to a depth that is far greater than that reached by erosion processes in a comparable time. The fact that soluble salts remain inside the stone explains the rapid development of deterioration. Scanning electron microscope pictures show that the crust has no protective value because it is crossed by channels and cracks which allow the penetration of water deposited on the surface by continuing condensation. If the process is allowed to proceed, entire pieces of marble may suddenly disgregate; complete carvings or parts of statues may so be lost in a matter of months.

Alveolar erosion

The second deterioration process that I wish to explain in detail is the *alveolar erosion* of soft porous stone, which used to be called *eolic erosion* because of the role the wind plays in it, although it is not the sole agent of the disease.

Besides wind, the main factors are water and soluble salts dissolved in it. These salts may be picked up by water from the ground (rising damp) or be carried by the wind itself in coastal areas.

Water penetrates into the porous material because it is drawn into the smallest pores by electrical attraction forces (capillary forces). Working its way into the material, water is drawn towards those surfaces on which evaporation is faster, in particular where the wind speed is higher.

Upon evaporation, crystals of salt are formed not on the surface of the stone but rather inside the pores, a few millimeters below the surface, because under the action of the wind the evaporation is so rapid that water can't even reach the surface.

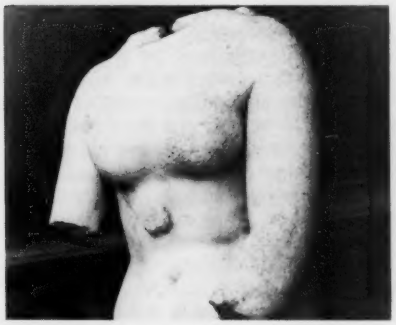
As crystallization causes stress, deterioration starts in the evaporation area and proceeds, increasing progressively its speed so that inch-deep cavities may be formed in relatively short times. Apparently, when a cavity is formed, high velocity air eddies form inside it, under the wind action, so evaporation inside the cavity is further accelerated. The phenomenon, therefore, is self-magnifying and may affect masonry to such a point as to cause structural trouble; a striking example is offered by the Temple of Juno in Agrigento.

It is interesting to note that, if things are as suggested above, the conservative provision that one would be tempted instinctively to take, which is to fill the cavities with a material impervious to water, is wrong. Actually if evaporation is blocked in the alveoles it will start somewhere else in the stone; the filling material would keep but more ancient material would be destroyed. A consistent filling policy might result in the complete substitution of the original material with the new one on the surface of the stone.

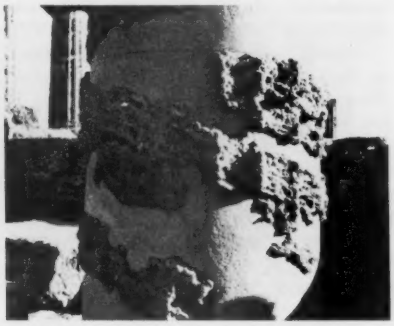
This example is quite useful to underline the importance of *diagnosis* in stone conservation before any action is taken. Diagnosis, in turn, is based on analysis, both of the stone and of the environment to which it is exposed.

If a stone is found to be affected by alveolar erosion, the *conservative intervention* should aim to control water circulation in the pores and to reinforce the original stone. Filling the cavities should come last and should be done with a material which is more porous and weaker than the original one, in order to direct the future deterioration on the filling rather than on the stone.

In all causes of stone deterioration, conservation must not be conceived as the application of some miraculous chemical product, or synthetic resin, which restores the strength of the material and protects it forever; to-day we definitely know that this is not possible. Stone conservation is instead an ensemble of provisions (chemical or other) which results in the retardation of stone deterioration processes; such provisions have only a finite useful life and must be periodically repeated. No stone can survive indefinitely in an aggressive environment without maintenance.

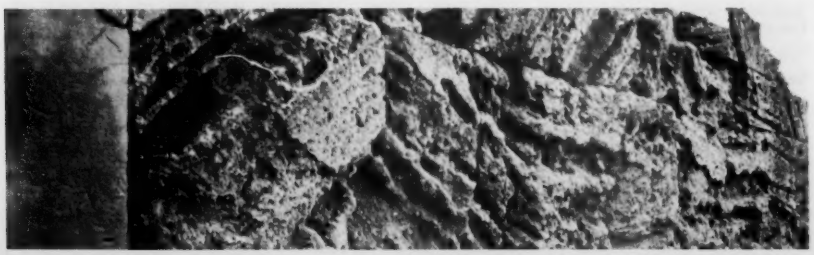


Cherchell (Algeria). The "Venus of Cherchell" shows signs of marble deterioration a few decades after excavation. The statue was sheltered under a porch, facing the sea. Condensation laden with marine salt is enough to inflict superficial damage to the marble, even in the absence of air pollution.



Agrigento (Italy). A column of the Juno temple has been "restored" by filling the erosion cavities with concrete. As deterioration is now shifted to the adjacent limestone, the original stone will be progressively destroyed; in the end all the stone would be covered with concrete.

Agrigento (Italy). The base of the Juno temple shows the effects of alveolar erosion on the soft, porous limestone. Erosion works along bands that correspond to layers of fine porosity of the sedimentary stone; water is drawn preferentially into the fine pores and evaporates inside them, near the surface, causing crystallization of soluble salts and internal stress.



Conservation of marble

A good example of modern techniques and attitudes is offered by the *conservation of marble*.

After diagnosis, the first, and essential, step is *cleaning*. As mentioned above, the dark weathering crust of marble does not protect the stone and, furthermore, it does not allow the application of a new protective material: it must be removed.

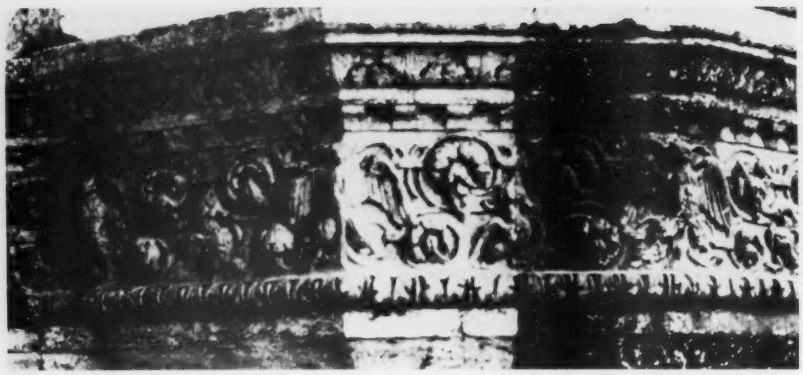
Cleaning, however, should be carried out avoiding any loss of marble and the creation of new cracks. This is not easy to achieve because of the weak resistance of marble to mechanical stress.

Most of the current methods of mechanical cleaning (such as sand blasting, wet grit blasting, metallic brushes operated by hand or machine, etc.) are damaging for the marble surface and should not be applied to objects of artistic or historic value.

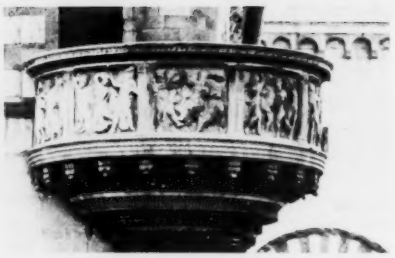
Also chemical cleaning methods which cause corrosion of calcium carbonate and yield soluble salts as by-products should be avoided; acids and caustic alkali fall in this category.

Marble submitted to such "fast" cleaning processes shows a surface that is intensely cracked and corroded thus favouring the future onset of deterioration.

New methods exist now which are far more delicate and cause the minimum possible damage to the delicate marble surface. Unfortunately such are more expensive because they



Bologna (Italy). Cleaning of Verona marble decoration. The stone is cleaned by repeated applications of a mildly basic jelly; patches of crust showing high resistance are removed by the micro-blasting (airbrasive) technique. After cleaning the stone is protected by a film composed of an acrylic resin and a silicone.



Prato (Italy). The marble pulpit of Donatello on the outside of the Cathedral. The pulpit was consolidated with fluosilicates in 1942 and started deteriorating again 30 years later. It was then removed and lodged in the nearby museum of the Opera del Duomo. The pulpit which appears in the picture is composed of epoxy resin castings made in 1976 from silicone rubber molds.

are slower and must be handled by specialized operators.

However, one at least is very simple. Water pulverized to a very fine mist and falling slowly on the stone is a surprisingly active cleaning agent, far more efficient than pressurized water jets or stream. Also it is far less damaging. The reason is due to the great specific surface of the fine water droplets, hence their great solvent power.

Other interesting new methods are some slightly basic jellies (containing bicarbonates, calcium-complexing agents and jellying agent) or the micro-abrasive blasting apparatus, called "Airbrasive."

In the hands of experienced operators such methods allow the elimination of the toughest crusts without causing undue damage to the marble.

When deterioration processes have already caused a loss of cohesion in the core of the marble which is threatened by complete disgregation, a *consolidation* process is required. Consolidation requires the use of deep impregnation techniques which allow penetration of the consolidating liquid up to the sound core of the stone, if there is one. If the whole piece is disgregrating it must be completely impregnated.

Deep impregnation of a single piece of marble is relatively easy in the laboratory, but is far more difficult if the stone is an integral part of a building. However even the latter cases may be solved by means of techniques in which the surface of the stone is kept wet with the consolidating liquid, for several hours or even days.

Experiments on such processes started as far back as the first quarter of the 19th century and a large number of them are available today. Notwithstanding the fact that many consolidation systems are quite successful, as they do restore the cohesion of deteriorated marble, on the whole they enjoy a rather bad reputation. Poor performance of consolidants in several large scale operations of the past may be ascribed to errors in the application technique (for instance to shallow penetration) but frequently also to insufficient consideration of the limitations of such processes.

A fundamental point is that consolidants reinstate cohesion in a crumbling stone but do not guarantee that the effect will last forever. Within time the consolidated crystals will crack again or the consolidant itself will become unable to stop the access of water because of its own ageing, and caused by oxygen and light.

If it is accepted that consolidated stone must also be protected in order to insure to it a satisfactory life, most of the objections against stone consolidants automatically fall.

A new material which shows some promise for the consolidation of marble is called ethoxy-silane and is related to silicones in structure. Ethoxy-silane molecules are rather small and contain a silicon-oxygen backbone, resembling a mineral structure, to which organic groups that contain carbon and hydrogen are connected.

Also present are some ethoxy groups which can react with water; actually this reaction happens after the ethoxy-silane molecules have penetrated into the stone, something they can do easily because their size is relatively small. The outcome of the reaction is that the molecules connect with each other and also with the stone crystals and consolidation is achieved.

The organic groups remain attached to the backbone of the molecule and form a water-repellant coating in the cracks and in the pores. Water can't gain access to the interior of the stone, so deterioration processes are delayed.

But even such a special molecule will not work miracles: in the long run its water-repellent groups will be oxidized; furthermore new cracks will open in the marble because of mechanical stresses. Deterioration will start again.

In view of the high cost of deep impregnation and of the damage inflicted to the stone by a new outburst of deterioration, it appears more convenient to entrust the *protection* of the consolidated stone to another material, situated completely out of the stone, rather than to the consolidant itself.

Protective films

A *protective film* is a sacrificial layer applied to the stone surface. It does not allow penetration of water but is progressively deteriorated by the weathering agents. Therefore it should be periodically replaced, as soon as its useful life approaches termination. Under the condition of periodic maintenance, a long life may be expected for consolidated marble, even if exposed to an aggressive environment.

If maintenance appears to be an exacting condition, one should consider that iron has long been efficiently protected in such a way and everybody regards this fact as obvious. Strangely enough, several curators of monuments appear to think that stone should be treated once for all time and preserved without any maintenance.

Also protective films have a bad reputation nowadays. As in the case of consolidants, the reasons are faulty applications and failure to recognize the limitations of the materials used.

A protective film must be applied on a clean and compact surface. This implies that a stone must be cleaned, if dirty, and consolidated, if incoherent. A film applied on a deteriorated surface will have no chance of success; curators however see it done frequently on historic buildings entrusted to their care and draw the conclusion that the fault is in the material used.

Metals, as we have seen, are in general treated much better than stone and resist well even in very aggressive environments.

Stone has also the disadvantage that only transparent films are accepted by curators for aesthetic reasons; such films are less resistant to weathering than pigmented ones, futhermore they cause tricky optical changes (e.g., the stone may appear wet all the time or its color may change) which are quite annoying for the general public.

Such difficulties however may be overcome by a little applied research and it is reasonable to think that a satisfactory compromise can be achieved between the requirements of aesthetics and protection.

Protective films have been applied on stone since early times. Centuries ago, in Fidenza (Italy) the bishop promised an indulgence to the faithful who would join in applying oil on the stones of the Cathedral. More recently in Washington, D.C., the sandstone of the west front of the Capitol was painted white to arrest deterioration (and to make it look like marble) and the painting has been repeated periodically ever since. Now, over a hundred years later, the painting layers have reached a thickness of several millimeters but the stone, on the whole, is keeping rather well.

New materials are now available, like acrylic resins or a wax extracted from mineral oil (microcrystalline wax). Protective films with a useful life in the range of ten years can be made and one may hope for better materials in the near future.

Environmental protection is another way to handle the protection problem. It includes several provisions that one can take in order to reduce the rate of deterioration by acting on the environment of the stone rather than on the material itself.

A simple example is the use of a heating system to keep the stone above the temperature at which condensation or frost may take place in it. The same result could be achieved by creating a cushion of warm air around the surface.

When all conservation methods fail, or curators are afraid to allow their use because of their bad reputation, the only possible protection is the removal of the stones from their aggressive environment and their recovery in a dry sheltered place. Remember that if condensation is allowed to take place, stone may be attacked even inside a building.

The principal aim that I pursued in this paper was to show that stone deterioration problems are rather well known and that a conservation policy is possible. There is no hope however that a miracle paint will allow us in the future to spray all buildings and monuments and to obtain everlasting conservation, with little work.

To the contrary, conservation is continuously jeopardized by the relentless action of the environment and it can be insured only if continuous attention, and maintenance, is applied to the stone objects that we wish to keep around us, in their original location, so they may continue to exert their influence on our everday life.

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A Guide to Buying and Maintaining Binoculars

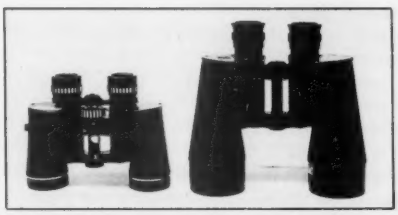
Brian Morin

For resource managers and park officers who are involved in the study of wildlife, or who need to view distant features or activities in greater detail, binoculars are a vital component of every field trip.

Often you will hear the terms field glasses and binoculars used interchangeably, but there is actually a substantial difference between the two. Field glasses function by means of glass lenses only, whereas binoculars have both glass lenses and prisms. The former are usually smaller and lighter, with smaller magnification and are also rather inexpensive. However, the lower power makes field glasses largely unsuitable for park work. In addition, field glasses are not as durable as most binoculars. A stiff jolt may well set them out of alignment, necessitating a trip to the repair shop. It's best to stay clear of them. This article will deal exclusively with binoculars, or more specifically, prism binoculars.

There is a wide range of models, styles and brands on the market to choose from, with prices ranging from less than U.S. $20 to many hundreds of dollars. The quality of the optics is equally variable, making selection a potentially confusing task.

This need not be the case. Before purchasing your binocular, consider the following fundamental points of binocular design and use and compare them with your own needs. Then remember that to protect your investment it is essential to take care in the handling of your binocular and to observe a routine schedule of maintenance. Quality optics can potentially last many decades if they receive the proper attention.



Prismatic type binoculars, now the most widely used. Binoculars of this type are available in a wide range of powers and objective lens sizes.

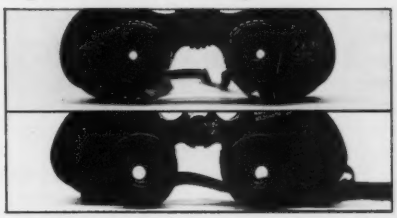
What do the numbers mean?

There is no great mystery to the numbering system applied to binoculars. The numbers are simply a code that is used to classify the various optical features. Once decoded, the information provides essential criteria that should be used in selecting the set that best suits your needs.

First of all, each model has two numbers (i.e., 8x40). The number preceding the 'x' denotes the power of magnification; 7 power brings an object 7 times closer than the naked eye; 8 power, 8 times, etc. The second number is an expression, in millimeters, of the diameter of the objective lens. The larger the objective lens, the greater the quantity of light that enters. This is an important consideration for viewing under low light conditions.

A binocular's *field of view* refers to the width of the area pictured as you look through it. Most optical companies quote the distance in reference to 1000 yards (914.4m) i.e., 386 ft. (118m) at 1000 yds. The narrower the field, the smaller the area viewed.

In addition to these basic points, consideration should be given to the size of the *exit pupil*. Expressed in millimeters, the exit pupil is the diameter of the area of light reaching the eye. It can readily be seen as the bright disc emitted from the viewing eyepieces or ocular lenses. The diameter is calculated by dividing the magnification into the diameter of the objective lens (i.e., an 8x40 mm binocular has a 5 mm exit pupil). The wider the exit pupil, the brighter and clearer the image.



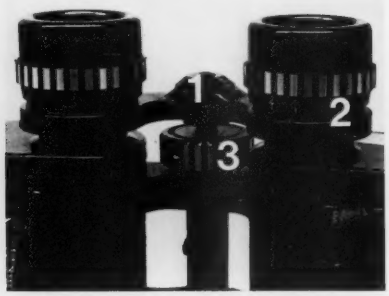
The bright circle in the center of each ocular lens is the "exit pupil." The larger it is the more light it will transmit to the eye. Above, 7 x 35; below 7 x 50.

Additional features

There are several other features that should be looked for in binoculars. Most models, nowadays, have a transparent optical coating to reduce reflections of light from the glass surfaces. This not only reduces glare, but also increases the amount of light reaching the eye. To maximize the effect, all lens and prism surfaces should be coated. Lesser quality binoculars may have only an exterior surface coating, letting in a much smaller percentage

Individual eyepiece Focusing
1. Interpupillary scale (in millimeters)
2. Focusing scale

Center Focusing
1. Interpupillary scale
2. Dioptric Focusing scale
3. Center focusing wheel



of light. Older un-coated lenses and prisms can be coated only at expert repair facilities.

Convenience in handling is every bit as important as the optical features. The equipment should suit your own personal requirements for bulk, ease of focusing and weight, just as most people buy a car based not only on its mechanical points, but on how it rides and drives.

Next to optical qualities, more binoculars are chosen on the basis of size and weight than any other features. The key here is personal suitability. Some people like a medium sized binocular that fits their hands well, while for others, the smaller the better. Weight can range from little more than half a pound (0.23 kg) for compact, low-power models, to over 3 pounds (1.36 kg). Remember that for extensive viewing, heavier binoculars are more tiring to handle and can add unnecessary weight on long walking trips.

Unless you always view your subjects at great distances, pick a glass with a center-focusing wheel rather than one that has individual eyepiece focusing. However, even on the center-focusing models, the right eyepiece should be adjustable to fit the precise focus adjustment that your eyes require. Once set, note the position of the calibrations for future reference in the event that the eyepiece is moved. Most binoculars also have a hinge at the center post for adjustment to the distance between an individual's eyes.

The ability to "pick up" moving subjects requires a focusing mechanism that responds quickly to the movement of your finger. Rapid focusing models have an arm extending from the right eyepiece that responds instantly to your right thumb and focuses both lenses. However, the better quality binoculars with center focusing use a lubricant that allows maximum ease in focusing, so you need not look for one of the "insta-focus" type.

If you wear eyeglasses, look for models with either collapsible or retractible rubber eyecups to ensure maximum field of view.

Choosing your binocular

Having given thought to these points, you should be about ready to select the model you need. I would recommend using the following criteria as a guide for meeting the requirements of park personnel and wildlife officers.

Field Glasses or Binoculars? — Binoculars. Some popular models are 7x35, 7x50, 8x36, 8x40, 9x36.

Magnification — Within the 6-10 power range, but preferably 7, 8 or 9 power. Six power tends to be too small a magnification and 10 power binoculars are usually heavy and bulky, with a narrower field of view. Very steady hands are required to use magnifications over 8 power.

Field of View — Choose a model that allows the maximum field possible in combination with the magnification. It should be at least 380 feet at 1000 yards.

Exit Pupil — The diameter should be 4 mm or greater.

Coated or Uncoated Lenses — Unquestionably coated.

Weight — Not more than 2½ pounds (1.14 kg.), 1 to 2 pounds (0.5-0.9 kg.) is ideal.

Brands — There are many high quality brand names on the market — Bausch and Lomb, Leitz, Zeiss, Bushnell, Canon, and Nikon, to mention just a few. Pick a reliable brand, one that is backed up by an acceptable warranty, and for which repair facilities are available to you.

Price Range — There is no set price that must be paid to obtain a good binocular, but generally you get what you pay for. Prices will of course vary, depending on geographic location, but I would suggest investing between U.S. $60-$200. You can pay over and over again at the repair shop for cheap models.

Handling and maintenance

If you want to ensure longevity for your binocular, it is important that it be treated with care. Common sense handling procedures suggest that you avoid bumping or dropping the instrument to prevent disalignment of the optics. When hiking in rough terrain, slip the binocular inside your shirt or jacket or hold tightly beneath your arm, with the strap securely over your neck.

If you live in an arid region where blowing dust and sand are a factor, keep the binocular inside the case until needed. In marine localities, where the equipment might be exposed to salt spray, a similar procedure might be followed, or you could use your outer apparel or a plastic bag as a shield. Should salt water fall on the binocular, wipe it off thoroughly as soon as possible to avoid corrosion.

Rain shields are available for many models to protect the exposed eyepieces when not in use on field trips. If you must use the glasses under such conditions, you can avoid getting water on the objective lenses by cupping your hands around the outer surface, like blinders. Avoid use in a downpour and be sure to dry the equipment once you are out of the rain.

If you have the misfortune to drop your binocular in fresh water, allow these procedures: (1) Remove the binocular from the water, but do not dry. Leaving the binocular wet will inhibit the growth of fungus that can damage the lens coating. Place in a plastic bag and, within 36 hours, take to the nearest depot that services binoculars. If this is not possible, dry off as much water as possible and expose the binocular to a stream of very dry air, as from an air conditioning unit. (2) If the binocular falls in salt water, rinse with fresh water as soon as possible and follow the same procedure as in (1) above. Some people prefer not to take binoculars along on boat or canoe trips. Sealed plastic bags can be used to store equipment safely in such circumstances.

Maintenance

Regardless of the price you pay for your equipment, your optics require regular attention. To clean:

1. Blow briskly on lenses and adjacent parts or use a soft brush to remove dirt or grit particles. Blower brushes are available. Grit is the worst enemy of lens surfaces.
2. Moisten the lenses by breathing to form a light mist, or use a recommended lens cleaning fluid.
3. Wipe clean in light circular movements, using lens tissue, lens cloth or a clean handkerchief.

Avoid leaving your binocular with the lenses exposed to direct sunlight when not in use and never, never try to take the instrument apart to remove dirt from interior lens or prism surfaces. You may well disturb the precision alignments of the optical units. If the interior surface needs cleaning, send the binocular to a reputable dealer or repair facility. Similarly, if the optics are out of alignment, forget about trying to make adjustments yourself. Misaligned optics can affect your vision, causing eyestrain and headaches.

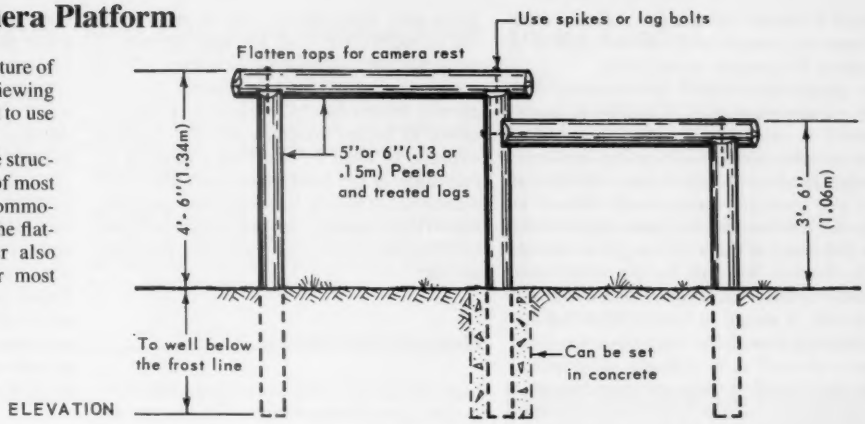
Modern binoculars are sturdy but care and maintenance is required. Most of this is merely the exercise of common sense. With a minimum of time and effort and by treating your binocular with the respect that it deserves, you will be able to protect your investment for many years.

Brian Morin is a planning officer with Parks Canada in Ottawa.

Binocular Rest and Camera Platform

A wall, fence post, bar or any firm structure of an appropriate height at overlooks or viewing areas is a great help to people who want to use binoculars or cameras.

Where such are not present the simple structure shown here would meet the needs of most visitors since the two levels could accommodate nearly anyone as an elbow rest. The flattened top of the horizontal member also should provide a steady platform for most cameras.


Use spikes or lag bolts
Flatten tops for camera rest
4'- 6"(1.34m)
5"or 6"(.13 or .15m) Peeled and treated logs
3'- 6" (1.06m)
To well below the frost line
Can be set in concrete
ELEVATION

A Museum Primer for Park Managers

Michael P. Paskowsky

Parks of all types are deep in the "preservation business." Whether it be a natural area protecting endangered species or a historic site protecting the scene of a famous incident, the park is entrusted with preserving some valuable resource. Despite the great differences in parks, the protection of material objects is frequently a common if somewhat overlooked concern. Historic areas are usually endowed with furnishings, documents, decorative arts, etc., but what about non-historic areas? What park contains no evidence of human, geologic or paleontologic history? Examination will almost certainly reveal a hebarium collection, important documents or works of art, or biological specimens hidden away in some file, closet or attic. All of these materials require the special care and attention of a museum professional. Ignoring these needs would be a gross dereliction of the preservation mandate.

Park managers need not feel helpless; there are measures that can help ensure the protection of these material resources. Employing the following basic principles, and consulting with professionals or available literature on more specific problems, can ensure protection of these valuable resources from the ravages of deterioration. The need for a trained and concerned staff is necessary for the continued preservation of historic artifacts in all parks — those with only a small display as well as those with massive exhibit halls. All historic artifacts, by their very nature, are worthy of special care and attention. One general maxim that should be followed by all parks is, *if it's worth keeping, it's worth maintaining properly.*

The most elementary characteristic of all "museum people" is a sensitivity for the objects and a desire to act as responsible stewards of the collection. It is important that an appreciation for the value and significance of the artifacts serve as the foundation for all museum activities. Once that vital perpective is established, work can begin on other levels.

The next step to successful museum management is the recognition of agents of deterioration. These can be grouped into four basic categories: climateological considerations, photochemical activity, infestation, and security.

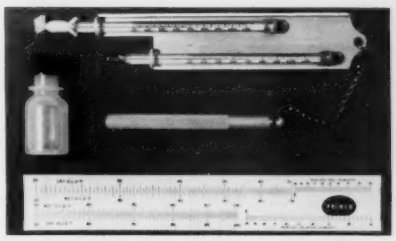
Climatological factors

Climatological considerations are often the most critical factor in the proper care, maintenance, and storage of museum objects. The goal is to create a stable environment with as little fluctuation in temperature and humidity as possible. Violent change can make materials expand, contract, split, crack, etc., with irreversible damage as a frequent result. The problem is compounded when an object is made up of a combination of materials; such as wood and leather or bone and fabric, for each material reacts to the environment differently.

Being subject to countless laws of physics, materials are engaged in a perpetual struggle to reach equilibrium, a state of balance between the different forces affecting them. For museum objects, we are concerned primarily about temperature and humidity. If an object (a chair for example) is normally kept at a relative humidity of 50%, it will adjust itself to exist at that environment; or in other words, to be in the state of equilibrium. Should that same chair be suddenly moved near a furnace, it will strive to reach equilibrium with its new environment, say 20% relative humidity in this case. The result would be that much of the moisture absorbed in the wood would be eliminated. Cracks would likely appear, particularly at the joints. This damage might have been avoided, even with such a drastic change in environment, had the change occurred over a period of time — perhaps weeks — so the materials could slowly adjust to the changing conditions.

Materials have inherent properties causing them to react differently to their environment and therefore they have specific storage and handling requirements. Generally, organic

Thermo–hygrometer and sling psychrometer are used to measure temperature and relative humidity.



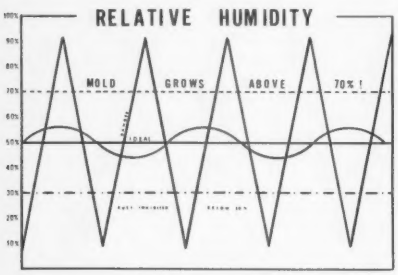
materials (those derived from living organisms — bone, leather, wood, fiber, etc.) are extremely sensitive to temperature and humidity changes. They are also susceptible to light damage and are prime targets for insect and rodent infestation. These factors must always be taken into consideration when dealing with organic materials.

Inorganic materials such as stone, metal and other non-living compounds, generally require less environmental controls. However, many materials are subject to inherent vices which contribute to their deterioration. Metals are susceptible to corrosion, glass and ceramics break easily. A curator or keeper,

trained in the care and treatment of many types of materials, should be on the park staff or be available for periodic consultation.

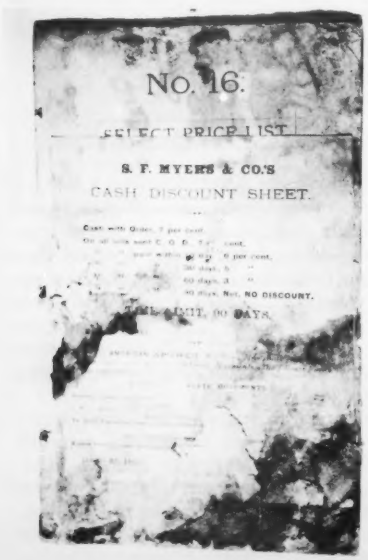
A relative humidity of approximately 55% and a temperature of 21°C (65°F) is recommended as an ideal. However, these values must be calibrated to conform with local conditions. In other words, to reach equilibrium with that particular environment. Hence, an optimum relative humidity level might be 20% in a desert region while 60% might be suitable in the tropics. To avoid the danger of mold growth, relative humidity should never exceed 65%. It should be kept in mind that differences can occur in the microenvironment of a room as well as in different geographical areas. Each park or museum must determine on an individual basis what climatic conditions are appropriate for its specific objects and its particular environment.

A number of special instruments are available to measure the precise conditions of a given area. Hygrometers, psychrometers and thermometers are used for this purpose. If these are not immediately available, a close approximation of local conditions can frequently be determined by consulting data acquired by nearby museums, weather stations, airports, or even by checking published information in the local newspaper. But exact measurement should be taken when possible. Remember, relative humidity inside a heated building may be radically different from that outside.



Ideal conditions for museum objects would be a constant 50% environment, as illustrated by the solid horizontal line. The wavy line, representing a fluctuation of 3%, is a reasonable goal for museum storage. Avoid wild fluctuations as shown by the jagged peaks and troughs. The broken horizontal lines illustrate important factors — conditions for mold growth and metal oxidation.

Mold growth seriously weakens this paper artifact.



Photochemical damage

Light damage is a serious but frequently overlooked agent of deterioration. The radiant energy of light, especially the invisible spectrum, increases the photochemical activity of molecules in the specimens. Loss or fading of color is one common symptom of this phenomenon, but other chemical changes including deterioration of adhesives and structural damage can occur. Silk is an extreme example; over half of its tensile strength can be lost after one month's exposure to light.

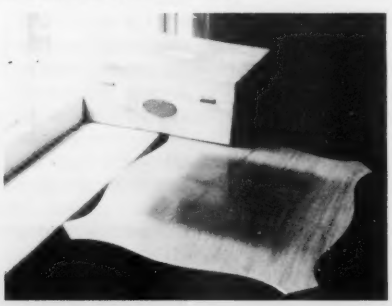
Light on museum objects should be kept to a minimum. Levels should not exceed 15 footcandles (150 lux), even less for sensitive items such as silk, bone and ivory. Light filters which substantially reduce both visible and invisible light can be applied to windows. Filter sleeves can be applied to fluorescent bulbs to reduce ultraviolet emissions; incandescent bulbs do not emit ultraviolet radiation. Common sense techniques such as removing specimens from direct exposure to sun and minimizing exhibit lighting can increase the longevity of specimens.

Infestation by pests

No area can be completely free from the threat of insect and rodent infestation. However, no excuse can be made to allow our cultural heritage to be destroyed by pests. Frequent inspection should be performed to detect early signs of insect infestation. Rodents characteristically leave droppings and evidence of chewing and gnawing can frequently be found. Silverfish *(Lepisma saccharina)* and cockroaches *(Blattaria sp)*, both nocturnal insects, frequently attack paper, textiles and other organic materials. Look in dark corners for the insects or their egg cases. Clothes moths *(Tinea pellionella)* in their larval form feed on wool, fur, hair, feathers and animal fibers. Always be on the lookout for these common pests and more exotic ones.

Good housekeeping and pest proof storage cabinets go a long way in deterring infestation. Should a serious problem occur, several options are available, including traps, fumigation, residual pesticides and insecticides. These procedures should be performed by someone knowledgeable in these techniques and who understands the effects of these compounds on the specimens and is aware of applicable restrictions on their use.

The outline of a box can be clearly seen on this sun-damaged table top.

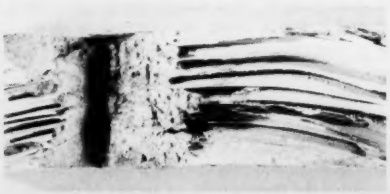


Physical security

Security is an important consideration in managing any resource, and museum objects are no exception to this general rule. Protection from theft, fire, vandalism, negligent damage and natural disaster is essential. Since many collections are located in isolated areas, response by law enforcement and other officials cannot be relied upon. The park should instead attempt to deter any threat to the security of the specimens. Strict accountability and efficient records keeping must be exercised, and access to storage and records areas must be controlled. Exhibited materials should be out of reach to reduce the risk of pilfering and to avoid the damage that is inherent in handling. The movement of specimens should be kept to a minimum for the risk of irreversible physical harm is always present.

Fire is a constant threat to museums, both from the damage of the fire itself and the problems caused by the fire suppression materials. Water and chemicals in addition to extinguishing the burning materials can harm the rest of the collection, either by direct contact or by creating an environment for possible mold growth. For this reason sprinkler systems should be avoided. Parks should focus on limiting the potential for fire by storing all flammable materials in special containers away from the collection, avoiding makeshift electrical wiring. Training personnel in the use of fire extinguishers, and preparing a plan for the evacuation of especially rare and valuable materials. Should the park be located in an area prone to floods, earthquakes or other natural disasters, early warning systems and emergency evacuation plans should be designed in cooperation with appropriate officials.

Example of termite damage to wood.



These basic principles should help the park manager to recognize the importance and special needs of historic and natural history specimens. The preservation of these important resources depends on the commitment of park managers together with the knowledge of trained professionals. Even if a park lacks a museologist, help is available. Large organizations such as the US National Park Service maintain their own preservation laboratories; smaller institutions frequently form collective or regional conservation centers. On the international level, organizations such as UNESCO, ICOM, and the International Centre for Conservation in Rome (see Parks, Vol. 1, No. 2, pp. 5-7) can be consulted. In addition, of course, there is an enormous amount of technical literature on almost all aspects of museum and collection management and maintenance.

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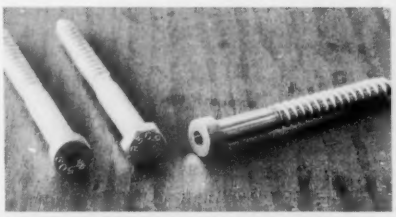
"Tamper-proof" Lag Bolts

Vandalism and the theft of park signs, emblems, or anything else attached to posts can be all but eliminated through the use of these modified lag bolts suggested by two members of the Grand Teton National Park staff.

Using a metal lathe, the hexagon heads of the lag bolts were machined round and a hole drilled in the center of the bolt heads. Work crews can easily install them in countersunk holes by using inexpensive auto mechanics' screw extractors, but vandals or thieves would find them impossible to remove without the special tool.

A bonus is the attractive appearance of the round-headed bolts, especially when countersunk.

This item originally appeared in *Grist* (March/April 1978).



Homemade Candle Light

From Ray Smutek, editor of *Off Belay,* a US magazine devoted to mountaineering, comes the following item about the use of candles for lighting:

For winter camping in igloos and snow caves I prefer a short, squat candle that will sit on a snow block without tipping. I usually make my own, starting with an empty can leftover from summer climbing lunches. Rather than fool with wicking, I just use a candle stub. The wax comes from old Christmas candles but can be purchased at most supermarkets if necessary.

The can must be shallow and not too large in diameter. Otherwise the wax won't melt properly and will not feed the wick. For example, I've found that a 3¼ ounce (92 gm) tuna can works beautifully; the wax is consumed slowly, uniformly, and completely. The next size larger tin, however, doesn't work well at all.

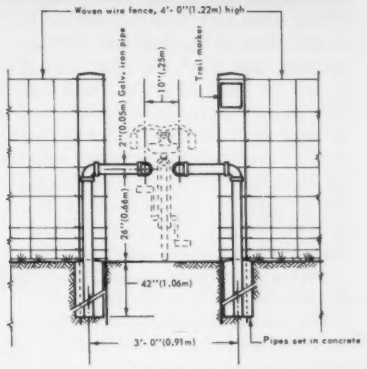
These candles have an extremely long life since none of the wax is wasted. In an igloo or snow cave, the open flame reflects off the snow surface, providing much more light than an enclosed candle lantern would. In a tent or other enclosure, fashion a reflector from aluminum foil.

Access Control

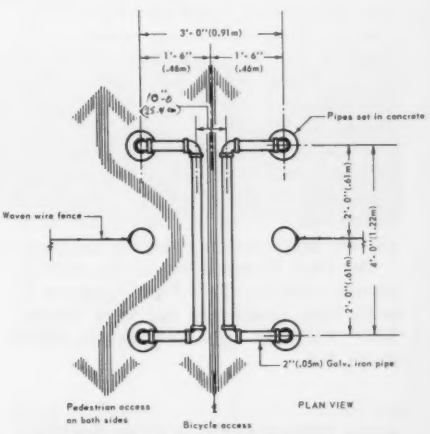
This simple control barrier, used by the US state of Michigan's Department of Natural Resources, permits access to trails by pedestrians or bicycles but keeps out motorcycles, snowmobiles, and larger vehicles, as well as horses or cattle.

Galvanized iron pipe of 2-inch (5.08 cm) diameter was used to construct this barrier. Pipe lengths were threaded and joined with 90° elbows. Upright sections were anchored in concrete footings.

This item *originally* appeared in *DESIGN* (April 1978).



ELEVATION VIEW



PLAN VIEW

Correction

In the article entitled "Basic Photo Equipment" in the last issue of PARKS, the text on page 15, at the top of the center column under the illustration, should read "... $^1/_{125}$th second ($^1/_{250}$th would be better), and a setting of $^1/_{250}$th or $^1/_{500}$th with a 300 mm lens."

BOOKS AND NOTICES

National Parks Planning (Forestry Paper No. 6), 1978, Food and Agriculture Organization of the United Nations, Rome, Italy, vii plus 41 pp.

The Forestry Department of FAO has been, and continues to be, involved in assisting member countries with the planning and management of their national parks. The original Spanish version of this manual was prepared by John Mosely, Kyran Thelen and Kenton Miller, while they were members of the team of specialists on the Regional Wildland Management and Environmental Conservation project for Latin America. There was, however, an urgent need for a similar publication in other parts of the developing world. In order to overcome this problem, members of the Wildland and Conservation Branch cooperated with their colleagues in the Latin America region to produce English and French versions of the document.

This is the English version, which became available in March of this year.

The manual incorporates a synthesis experience gained by FAO in this field and is illustrated with annotated examples drawn from the plans of individual national parks of many parts of the world, which are acknowledged.

In three basic sections are headed (1) The Resource, (2) Background Information, and (3) Management and Development. The manual is not a textbook but a guide on what data are needed and how they should be presented, in the fundamental steps for planning national parks and related areas. Other units found in park systems, such as cultural monuments or biological reserves, for example, can be planned by following this guide.

The FAO Technical Papers are available through authorized FAO Sales Agents or directly from Distribution and Sales Section, FAO, Via delle Termi di Caracalla, 00100 Rome, Italy.

Access National Parks, A Guide For Handicapped visitors, 1978, National Park Service, U.S. Department of the Interior, Washington, D.C., xviii plus 188 pp.

One of the shortcomings of nearly all public buildings — including park visitor centers — has always been the absence of even the most basic facilities for handicapped people. Far too often such barriers as flights of steps, curbs, narrow entry ways, inadequate comfort stations and the like have made it impossible for people in wheel chairs, people who are lame, blind or otherwise handicapped, to make use of structures and take part in activities that should be available to them as freely as to other members of the public.

In recent years this shortcoming has been addressed in a number of countries, and corrections are being made in existing facilities and new construction. The U.S. National Park Service is one official U.S. agency that is now engaged in this effort, and this small book is evidence of progress toward the goal of providing beneficial, comfortable and enjoyable park visits for everyone.

Access surveys 15 classes of NPS areas ranging from the great national parks to small historic sites, and covers the entire U.S. system. Entries are arranged by states, and each provides data on facilities — and also their absence. Entries include address, location, geographic information, facilities for handicapped, existing barriers, visitor information, lodging and restaurants, medical services, and data on the park programs.

Compiled by Adele N. Wilson, the guide took eight months to prepare for publication. Eventually it will be issued in Braille & recorded form.

Since installation of new facilities and modification of old ones is an on-going program, the book is already out-of-date. It's mere existence, however, is extremely significant.

The guidebook can be purchased for $3.50 through the Superintendent of Documents, Government Printing Office in Washington, D.C. Park personnel in developing countries may obtain a complimentary copy by addressing a request to: Office of Communications, National Park Service, U.S. Department of the Interior, Washington, D.C. 20240/USA.

Second Canadian National Parks Conference

The second *Canadian National Parks: Today and Tomorrow* conference will be held at The Banff Centre, Banff, Alberta, October 8 to 13, 1978. To be known as "Conference II, Ten Years Later" the international meeting is being organized by the National and Provincial Parks Association of Canada; Faculty of Environmental Studies, University of Waterloo; and Parks Canada. The School of the Environment, The Banff Centre will host the event.

About forty papers are being prepared for Conference II, the authors drawing upon their experience in Canada and in several other countries. All persons interested are invited to register for the conference. Registration fee is $48 and the banquet ticket cost $15. Further details are available from: Mr. John R. Amatt, Manager, Environmental Programs, The Banff Centre, Box 1020, Banff, Alberta, TOL OCO, Canada.

5th International Seminar on Natural Areas and Tourism

Under the sponsorship of the Secretary of Tourism and of the Director General of Tourism of the Province of Chubut, the 5th International Seminar on Natural Areas and Tourism will be held in that province of Argentinean Patagonia in October and November, 1978.

The Seminar will be in three parts. The first will be October 21 to 28, in the northeastern sector of the province, including the cities of Rawson, Puerto Madryn and the Valdes Peninsula. The second part, October 29 and 30, will be in the south of the province, in the area of the oil fields of Comodoro Rivadavia, Rada Tilly and Sarmiento city, near the Ormachea petrified forest. From October 31 to November 4, the third part will be held in the northwestern corner of Chubut, in an area embracing the cities of Esquel and Trevelin and Los Alerces National Park.

The touristic use of "marine natural areas", "geological natural areas", and "forestry areas and national parks" are the respective general topics of the Seminar's three parts.

Concerned individuals and institutions from all countires are invited to participate. Registration may be *total* (US$400 the three parts) or *partial* (US$150 each part). These amounts cover the expenses for lodging, food and transportation inside the province. Checks must be sent to the order of "Asociacion Geografica de la Patagonia:" Codigo Postal 9120, Puerto Madryn, Chubut, Argentina.

Following the 5th International Seminar on Natural Areas and Tourism, a program of lectures organized by the Asociacion Amigos de los Parques Nacionales, de Argentina, will be held in Buenos Aires, November 6 to 10.

View of Culzean painted by Alexander Naysmyth (1758-1840). The Home Farm, which has now been converted and restored as the Culzean Country Park Center, is pictured at the left. Culzean Castle stands beyond it on the cliff top.

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